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ABSTRACT

The "Show-Me Standards" as detailed in this guide are comprised of 33 performance (process) standards and 40 knowledge (content) standards. The performance standards include important process skills and the knowledge standards provide a solid foundation of knowledge in communication arts, fine arts, health and physical education, mathematics, science, and social studies. Missouri's Framework for Curriculum Development provides districts with a "frame" for building curricula using Show-Me Standards as a foundation. District curriculum guides furnish the interior curricular plan and appropriate instruction. This guide provides teachers with information and strategies for integrating the curriculum described in each separate framework. The five sections cover: (1) what curriculum integration is; (2) how to get started; (3) development of integrated units, projects, and activities; (4) reasons for integrating the curriculum; and (5) assessment of student performance. (Contains 56 references.) (ND)

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Framework for Curriculum Development

Integrating Curriculum Within and Across Subjects

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SB 37392

Missouri Department of Elementary and Secondary Education
Robert E. Bartman, Commissioner of Education

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The *Practitioner's Guide* represents a collaborative thinking, writing, and research effort among the Integration Writing Team and a host of Missouri teachers and administrators who provided information and guidance to the Writing Team. The Writing Team included the following individuals: Rodney L. Custer and Michael L. Walker, co-advisors; Gregory W. Thompson, project manager; Patrick N. Foster and Randall T. MacPherson, graduate research assistants. At the time of the writing all were affiliated with the University of Missouri-Columbia, College of Education.

Additional copies of *Missouri's Frameworks for Curriculum Development* may be ordered for Communication Arts, Fine Arts, Health Education/Physical Education, Mathematics, Science, Social Studies, and Integrating Curriculum. Check the Missouri Department of Elementary and Secondary Education (DESE) Home Page at: http//services.dese.state.mo.us/divinstr/curriculum/index.html

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PREFACE

In recent years, people from all walks of American life have participated in wide-ranging discussions about the direction of American education. While the situation is not as dire as some critics would have us believe, there is clearly a need for the review of current school organization, curricula, teaching practices and academic standards for students. As a result of these discussions, many legislators, educators, parents, and business leaders across the nation have initiated projects designed to develop high academic standards in safe learning environments for all students. The Show-Me State is no exception.

A Vision for Missouri Schools

In charting a path for the future of Missouri public schools, a common vision of what that future looks like is an essential first step. These schools must be physically and intellectually safe places for students. In these schools we believe all students are capable of learning and are challenged by high expectations. To meet this challenge, students must have a solid foundation of basic knowledge and skills. In addition, they must also be able to apply what they know.

To support the development of such students, teachers actively engage them in exploring, analyzing and understanding the world. Learning is interesting, hands-on and has real applications that are important to students. We recognize that students learn better, remember more, and develop deeper understandings of both knowledge and thinking processes if they have the opportunity to actively explore content and concepts. They view learning as the on-going process of extending and fine tuning their ideas and understanding through application. As a result, they take responsibility for their own learning, see its worth and make connections to the world beyond the classroom.

In addition, teachers and administrators in these communities see themselves as learners. They gain greater insight into their profession from their experiences among their students and in contact with their colleagues. They constantly seek to extend their knowledge and expertise, and frequently engage in professional development activities to deepen their professional skills and understanding.

The schools we envision also involve parents, business leaders and interested citizens in a multitude of educational activities. In turn, these people accept the responsibility for supporting and nurturing the learners within the school and see themselves as an important part of the learning community.

The Outstanding Schools Act

The passage of the Outstanding Schools Act in 1993 signaled Missouri's commitment to a public school system that purposefully prepares young people for the 21st century and assures our state's continued economic vitality. The Show-Me State has issued an ambitious, common-sense agenda by setting challenging academic standards for all students, by supporting professional development of educators to improve the quality of curriculum and instruction, and by providing more equitable funding for public education. In addition, the Outstanding Schools Act calls for increased accountability in improving student academic performance for all of Missouri's public school districts and school buildings. In summary, it addresses the following initiatives:

The Show-Me Standards—a set of 73 rigorous standards–intended to define what students should know and be able to do by the time they graduate from Missouri's public high schools;

Curriculum Frameworks—frameworks for curriculum development in communication arts, fine arts, health and physical education, mathematics, science, social studies and curriculum integration–intended to provide assistance to districts in aligning local curriculum with the Show-Me Standards;

A New Statewide Assessment—a new assessment system of performance events and multiple choice and short answer questions–intended to provide an indication of how well students are meeting the Show-Me Standards and how well they compare academically with other students across the nation;

Professional Development for Educators—one percent of the local district's basic state aid and one percent of the state educational budget to be set aside to support professional development–intended to improve student performance through improving the performance of educators; and

Professional Standards for New Educators—professional standards defining what graduating pre-service teachers should know and be able to do as certificated Missouri teachers–intended to ensure that there is a strong link between teacher preparation and the expectations of the school community.

Strategies for Including All Students

We believe virtually all students are able to learn, even though all students are not succeeding in school. Many of them fall behind and leave school before graduation. These strategies help all students become more engaged in learning:

- Use a multisensory approach to teaching and learning, including auditory, visual and hands-on techniques
- Present concepts in several ways, linking them to what students already know and checking frequently for understanding
- Model learning strategies and encourage students to talk about their own thinking and learning processes
- Teach students how to organize their thoughts using drawings, charts, outlines, thumbnail sketches, and computer generated flowcharts, spread sheets, and databases, etc.
- Encourage students to use technology as a user-friendly tool for learning
- Use questions and approaches that require inquiry, problem solving and the synthesizing of ideas
- Provide equal opportunities for all students to participate in class activities
- Adapt materials to accommodate students with special needs
- Provide real-life and work applications of what students should know and be able to do
- Develop a classroom assessment program that allows all students to show what they know and can do

Technology in Missouri Education

The Outstanding Schools Act also provides funding through technology grants for districts to obtain and access the latest technologies. The Show-Me Standards emphasize understanding and use of technology as a tool for learning, and *Missouri's Frameworks for Curriculum Development* suggest many ways to incorporate the use of technology in the classroom. Because students learn and demonstrate knowledge in a variety of ways, technologies can help teachers accommodate the learning and presentation styles of each student, keep students on task, provide individualized assistance and support students who must be absent from class.

Technology also plays a major role in adequately preparing students for continuous learning and for the workplace. More households are becoming dependent on technology (such as subscribing to on-line banking and informational services and operating computers, VCRs, CD-ROMs and voice mail). Growing numbers of jobs require an understanding or use of technology. In fact, we cannot imagine the impact technology will have on the lives of our children and grandchildren.

An important outgrowth of technology in our schools is that it may also enhance the local economy by encouraging schools and communities to share technologies and training. Through the Outstanding Schools Act, our students and other community members will have opportunities to become technologically literate.

The Missouri School Improvement Program

The Missouri School Improvement Program (MSIP) provides additional support to these measures by requiring districts to have a long-range plan for ongoing curriculum development and revision, to develop written curriculum guides for all curricular areas, and to implement the stated curriculum. In the second cycle of reviews (1996-2001), MSIP teams will evaluate whether a district's written curriculum addresses the Show-Me Standards. Curriculum guides for at least one content area must be revised to reflect the Show-Me Standards one year after the adoption of *Missouri's Frameworks for Curriculum Development* by the State Board of Education. Guides for the six content areas contained in the frameworks must be revised to address the Show-Me Standards by the start of the 2000-2001 school year. In planning for curriculum development and revision, districts may wish to consider the Department's schedule for implementation of the new assessment system:

Mathematics	Spring 1997
Communication Arts	Spring 1998
Science	Spring 1998
Social Studies	Spring 1999
Health/Physical Education	Spring 2000
Fine Arts	Spring 2000

The first administrations of the mathematics, communication arts, and science assessments will be voluntary. Districts will be required to administer the new mathematics assessment in 1998 and the new communication arts and science assessments in 1999. At the time each test is required, the *Missouri Mastery and Achievement Test* (MMAT) will no longer be used to collect state achievement data. The remaining subject areas will be required as noted in the above list.

Important curricular areas not included in the state assessment, such as foreign languages and practical arts, will find that the Show-Me Standards encompass knowledge and skills that are applicable for their students as well. In fact, the Show-Me Standards should be integrated throughout the entire K-12 curriculum so that all high school graduates will be better prepared to meet the challenges of the 21st century.

The Show-Me Standards

The Outstanding Schools Act requires that the State Board of Education oversee the development of "not more than 75 academic performance standards." The Show-Me Standards, developed over a period of two years with input from teachers, school officials and citizens, are the result of this mandate. There are **40 *knowledge (content) standards*** that provide a solid foundation of knowledge in communication arts, fine arts, health and physical education, mathematics, science, and social studies.

Business and higher education communities have pointed out that, in general, students are graduating with some factual knowledge, but they are not skilled in abstract thinking, problem solving, and working cooperatively or collaboratively. Students need practice in integrating, applying and transferring what they are learning in one context or content area to new and different situations. To remedy this, the Missouri teachers who developed the Show-Me Standards proposed **33 *performance (process) standards***. These standards include important process skills that students should master in order to successfully gather, analyze and apply information and ideas; communicate effectively within and beyond the classroom; recognize and solve problems; and make decisions and act as responsible members of society. (The Show-Me Standards follow this Preface.)

While intended to establish higher expectations for **all** of Missouri's students, the 73 Show-Me Standards do not represent everything a student should or will learn. Graduates who meet these standards, however, should be well-prepared for further education, work, and civic responsibilities.

The Department of Elementary and Secondary Education believes that the preservation of local control is a hallmark of the Outstanding Schools Act. Local school districts have the authority, the ability and the resources to develop rigorous and challenging curriculum that will prepare their students to be successful in the 21st century. The Department's role is to support districts in this endeavor, helping them carry out this task by offering technical assistance, professional development opportunities, and new technologies. Each school district must determine how its curriculum will be structured and which methods to use to implement that curriculum in the classroom. We believe that local educators, parents, employers, and community leaders know best how to incorporate the Show-Me Standards into their districts' curricula to meet the needs of their students.

Missouri's Frameworks for Curriculum Development

Missouri's Frameworks for Curriculum Development in communication arts, fine arts, health and physical education, mathematics, science, social studies, and curriculum integration acknowledge that teachers will bring the vision, ideals and principles of the Show-Me Standards into their classrooms in exciting and innovative ways. The role of the frameworks is to provide districts with a "frame" for building curricula using the Show-Me Standards as a foundation. District curriculum guides furnish the interior curriculum plan and appropriate instruction. District guides probably are not organized in the same way as the six content frameworks. The good news is that they do not have to be. In fact, although the frameworks use a three-column format ("What All Students Should Know," "What All Students Should Be Able to Do," and "Sample Learning Activities"), the committees who wrote the frameworks approached their task in ways that best appeared to fit their particular content areas. For example, the social studies framework is organized around important questions; communication arts, around the four goals of the Show-Me Standards; and science, around the knowledge standards. Each group of framework writers had valid reasons for their organizational plan, just as curriculum developers in each district will and should. Similarly, local curriculum guides should be in a format that is the most useful for the district's teachers.

Curriculum Frameworks Are Resources–

- To assist districts in developing curriculum consistent with the Show-Me Standards
- To indicate what students should know and be able to do by the end of grades 4, 8 and 12.
- To support teachers in providing high-quality learning experiences for **all** students
- To suggest examples of hands-on, real-world activities and classroom performance assessments
- To suggest effective learning and teaching strategies supported by research and practice
- To initiate discussions concerning curriculum integration within and across classrooms
- To provide examples of quality student work requiring knowledge and application of that knowledge

Curriculum Frameworks Are Not–

- Not required by law for district use
- Not detailed lesson plans or curricula
- Not items on which all students must be tested
- Not directives for uniform programs or textbook adoption
- Not mandates for inclusion of specific teaching methods or programs
- Not a format that all district curriculum guides must follow

As the writers worked on developing the frameworks, they asked themselves questions that are very similar to what local curriculum developers must ask: How do we see the Show-Me Standards playing out in this content area and across the curriculum? Are there important areas addressed by the standards that are not included in our current curriculum and how should we address these? Are we presenting a balanced curriculum, K-12? Are we giving students opportunities to apply in real situations the knowledge they have learned? How will the emphasis on what students know and are able to do change instruction, or will it? Do our assessments model and support the taught curriculum? In essence, the framework writers have tried to make the work of local curriculum committees easier by establishing a relationship between the Show-Me Standards and the K-12 curriculum in the six content areas. For some districts this step is unnecessary; for others, it will help give much needed direction.

In addition, the frameworks provide indicators of what students should know and be able to do by the end of grades 4, 8 and 12. They contain suggested resources, discussions of issues and current practices, and examples of quality student work. Many of the suggested activities encourage an integrated, interdisciplinary curriculum. In fact, the final section of *Missouri's Frameworks for Curriculum Development* provides a discussion of how districts might begin to explore the advantages of curriculum integration.

Meeting the Challenge

We know that, in most cases, the level of expectation and the interest of the students determine the level of performance. When schools set high standards and provide access to meaningful curriculum for every learner, students and teachers flourish. Success for all students is not a dream but a reality.

With the advent of the 21st century, we are on the threshold of more life-changing events than we can ever imagine. Computers and technology are making our lives both more productive and more complex. The Internet, fax machines, fiber-optic networks, and voice mail are changing the ways we communicate and do business. Information on every topic is readily available at the push of a button. Two bread-winners per family are the norm rather than the exception. Workers can no longer select a particular career and expect to do the same job in the same way year after year. As citizens, we must be prepared to make important decisions which will affect the lives of future generations in positive ways. The challenge we face now is how to educate our children to be successful as individuals and as members of society in a world that most of their grandparents would not even recognize. Working together, we can do it. What an exciting time to be involved in the education of Missouri's students!

THE SHOW-ME STANDARDS

Authority for the Show-Me Standards: Section 160.514, Revised Statutes of Missouri, and the Code of State Regulations, 5 CSR 50-375.100

PERFORMANCE (PROCESS) STANDARDS

GOAL 1: Students in Missouri public schools will acquire the knowledge and skills to gather, analyze and apply information and ideas.

Students will demonstrate within and integrate across all content areas the ability to

1.1 develop questions and ideas to initiate and refine research
1.2 conduct research to answer questions and evaluate information and ideas
1.3 design and conduct field and laboratory investigations to study nature and society
1.4 use technological tools and other resources to locate, select and organize information
1.5 comprehend and evaluate written, visual and oral presentations and works
1.6 discover and evaluate patterns and relationships in information, ideas and structures
1.7 evaluate the accuracy of information and the reliability of its sources
1.8 organize data, information and ideas into useful forms (including charts, graphs, outlines) for analysis or presentation
1.9 identify, analyze and compare the institutions, traditions and art forms of past and present societies
1.10 apply acquired information, ideas and skills to different contexts as students, workers, citizens and consumers

GOAL 2: Students in Missouri public schools will acquire the knowledge and skills to communicate effectively within and beyond the classroom.

Students will demonstrate within and integrate across all content areas the ability to

2.1 plan and make written, oral and visual presentations for a variety of purposes and audiences
2.2 review and revise communications to improve accuracy and clarity
2.3 exchange information, questions and ideas while recognizing the perspectives of others
2.4 present perceptions and ideas regarding works of the arts, humanities and sciences
2.5 perform or produce works in the fine and practical arts
2.6 apply communication techniques to the job search and to the workplace
2.7 use technological tools to exchange information and ideas

GOAL 3: Students in Missouri public schools will acquire the knowledge and skills to recognize and solve problems.

Students will demonstrate within and integrate across all content areas the ability to

3.1 identify problems and define their scope and elements
3.2 develop and apply strategies based on ways others have prevented or solved problems
3.3 develop and apply strategies based on one's own experience in preventing or solving problems
3.4 evaluate the processes used in recognizing and solving problems
3.5 reason inductively from a set of specific facts and deductively from general premises
3.6 examine problems and proposed solutions from multiple perspectives
3.7 evaluate the extent to which a strategy addresses the problem
3.8 assess costs, benefits and other consequences of proposed solutions

GOAL 4: Students in Missouri public schools will acquire the knowledge and skills to make decisions and act as responsible members of society.

Students will demonstrate within and integrate across all content areas the ability to

4.1 explain reasoning and identify information used to support decisions
4.2 understand and apply the rights and responsibilities of citizenship in Missouri and the United States
4.3 analyze the duties and responsibilities of individuals in societies
4.4 recognize and practice honesty and integrity in academic work and in the workplace
4.5 develop, monitor and revise plans of action to meet deadlines and accomplish goals
4.6 identify tasks that require a coordinated effort and work with others to complete those tasks
4.7 identify and apply practices that preserve and enhance the safety and health of self and others
4.8 explore, prepare for and seek educational and job opportunities

KNOWLEDGE (CONTENT) STANDARDS

Communication Arts

In Communication Arts, students in Missouri public schools will acquire a solid foundation that includes knowledge of and proficiency in

CA 1 speaking and writing standard English (including grammar, usage, punctuation, spelling, capitalization)
CA 2 reading and evaluating fiction, poetry and drama
CA 3 reading and evaluating nonfiction works and material (such as biographies, newspapers, technical manuals)
CA 4 writing formally (such as reports, narratives, essays) and informally (such as outlines, notes)
CA 5 comprehending and evaluating the content and artistic aspects of oral and visual presentations (such as storytelling, debates, lectures, multimedia productions)
CA 6 participating in formal and informal presentations and discussions of issues and ideas
CA 7 identifying and evaluating relationships between language and culture

Fine Arts

In Fine Arts, students in Missouri public schools will acquire a solid foundation that includes knowledge of

FA 1 process and techniques for the production, exhibition or performance of one or more of the visual or performed arts
FA 2 the principles and elements of different art forms
FA 3 the vocabulary to explain perceptions about and evaluations of works in dance, music, theater and visual arts
FA 4 interrelationships of visual and performing arts and the relationships of the arts to other disciplines
FA 5 visual and performing arts in historical and cultural contexts

Health/Physical Education

In Health/Physical Education, students in Missouri public schools will acquire a solid foundation that includes knowledge of

HP 1 structures of, functions of, and relationships among human body systems
HP 2 principles and practices of physical and mental health (such as personal health habits, nutrition, stress management)
HP 3 diseases and methods for prevention, treatment and control
HP 4 principles of movement and physical fitness
HP 5 methods used to assess health, reduce risk factors, and avoid high risk behaviors (such as violence, tobacco, alcohol and other drug use)
HP 6 consumer health issues (such as the effects of mass media and technologies on safety and health)
HP 7 responses to emergency situations

Mathematics

In Mathematics, students in Missouri public schools will acquire a solid foundation that includes knowledge of

MA 1 addition, subtraction, multiplication and division; other number sense, including numeration and estimation; and the application of these operations and concepts in the workplace and other situations
MA 2 geometric and spatial sense involving measurement (including length, area, volume), trigonometry, and similarity and transformations of shapes
MA 3 data analysis, probability and statistics
MA 4 patterns and relationships within and among functions and algebraic, geometric and trigonometric concepts
MA 5 mathematical systems (including real numbers, whole numbers, integers, fractions), geometry, and number theory (including primes, factors, multiples)
MA 6 discrete mathematics (such as graph theory, counting techniques, matrices)

Science

In Science, students in Missouri public schools will acquire a solid foundation that includes knowledge of

SC 1 properties and principles of matter and energy
SC 2 properties and principles of force and motion
SC 3 characteristics and interactions of living organisms
SC 4 changes in ecosystems and interactions of organisms with their environments
SC 5 processes (such as plate movement, water cycle, airflow), and interactions of Earth's biosphere, atmosphere, lithosphere, and hydrosphere
SC 6 composition and structure of the universe and the motions of the objects within it
SC 7 processes of scientific inquiry (such as formulating and testing hypotheses)
SC 8 impact of science, technology, and human activity on resources and the environment

Social Studies

In Social Studies, students in Missouri public schools will acquire a solid foundation that includes knowledge of

SS 1 principles expressed in the documents shaping constitutional democracy in the United States
SS 2 continuity and change in the history of Missouri, the United States and the world
SS 3 principles and processes of governance systems
SS 4 economic concepts (including productivity and the market system) and principles (including the laws of supply and demand)
SS 5 the major elements of geographical study and analysis (such as location, place, movement, regions) and their relationships to changes in society and environment
SS 6 relationships of the individual and groups to institutions and cultural traditions
SS 7 the use of tools of social science inquiry (such as surveys, statistics, maps, documents)

INTEGRATING CURRICULUM WITHIN AND ACROSS SUBJECTS

INTRODUCTION

What will students need to be successful in their world? What kind of knowledge and skills will they need? According to some futurists, citizens of the next century will need

- a high capacity for abstract, conceptual thinking
- the ability to apply their high capacity for abstract thought to complex, real-world problems, including the use of scientific, mathematical and technical knowledge with a focus on more than one right answer
- the ability to function in an environment where communication skills are vital
- the ability to work easily and well with others, to resolve conflict, and to work well without close supervision. (Marshall, 1992)

In short, they will need both the abstract, theoretical thinking skills with which we have been preparing the "college-bound" **AND** the technical, vocational, real-world skills with which we have been preparing the vocationally bound. Either without the other will leave our schools' graduates unprepared for their future. If the current structure of schooling and curriculum are not fully delivering these skills, in what kind of school environment are students likely to acquire them? In the opinion of many teachers, a combination of applying learning to real-world problems set within real-world contexts and integrating the curriculum within and across the subject areas offers the potential to help students become better prepared for their futures.

This final portion of *Missouri's Framework for Curriculum Development* provides teachers with information on and strategies for integrating the curriculum described in each separate Framework. Although this section contains a wealth of information for teachers wanting to initiate integrated learning, it does not provide an integrated curriculum. Rather, it provides background on (and several examples of) the variety of forms integrated planning, instruction and learning may take. With that in mind, this section is organized as follows:

- **What is integration?** a definition of and argument for integrating curriculum within and across subject areas.
- **How does one get started?** discussion of implementation issues ranging from scheduling and planning time to several models for organizing the curriculum and restructuring the school.
- **How does one develop integrated units, projects and activities?** discussion of a step-by-step process for creating and evaluating integrated units of study.

- **Why integrate?** discussion of arguments from cognitive theory and business in support of integrating curriculum to enhance students' acquisition and retention of concepts and skills.

- **How does one assess student performance?** discussion of processes and tools available to assist classroom teachers in assessing their students' performance on active, integrated projects and activities.

WHAT IS CURRICULUM INTEGRATION?

To integrate is to form, coordinate, blend or weave into a functioning or unified whole. Defined this broadly, integration is a response to separation—separation of abstract, conceptual knowledge from practical, meaningful application of that knowledge; separation of naturally related fields of study from each other; separation of one group of students perceived to be college bound from another group of students perceived to be bound for work. For some, integration is a response to helping prepare students for their future; for others, integration is a response to helping students remember what they have been taught. For still others, integration is a vehicle for helping students examine knowledge from different perspectives. Whether the focus of integration is connecting reading to writing, geography to economics, matter and energy to force and motion or more broadly mathematics to science or even academic to vocational education, the result is the same. Integration offers students opportunities to connect what they are learning in one subject to framing and solving the problems encountered in other subject areas and in the real world.

Although integration affords great opportunities, it also presents teachers and students with considerable challenges. Schools structured to support subject-based study often find it difficult to accommodate the needs of faculty and students trying to connect learning—even within subject areas. Teachers trained to work alone at essentially their own pace often find it difficult to collaborate and communicate with their colleagues. Subject areas that have for so long been asked to prepare students for college transcript analysis often find it difficult to identify their relevance to other subjects or to the real world. For their part, students of all ages trained to wait for teachers or textbooks to tell them the one correct answer often find it difficult to suspend their frustration when the problem encountered in one setting requires solutions and skills found somewhere else. How often, for example, does one overhear a student say, "This is math class. I don't need to know how to write in here. That's what we do in English."

Above all, teachers wanting to try curriculum integration—whether within their own subject areas, across traditional partner subjects, across the core, or across the core and vocational-technical areas—must accept that integration is a process not an event. When teachers seek integrated products, they often find merely fun activities. On the other hand, when seen as a process, integration leads us to ask the same kinds of questions that our students ask us: How will I use this skill? Why is this important? Answering these questions for ourselves and helping students discover their own answers enlivens teaching and establishes motivation and relevancy for learning. Over and over, teachers report how quickly they discover that students previously thought incapable of abstract, conceptual thinking surprise themselves and their teachers with their abilities.

What Forms Does Curriculum Integration Take?

From Within Subject Areas to Across Subject Areas

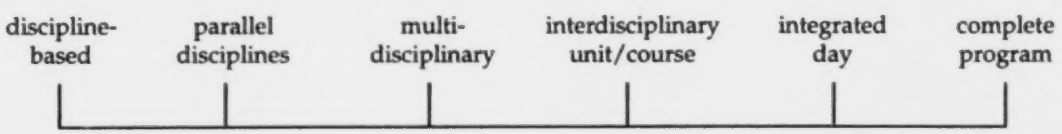
Missouri's *Show-Me Standards* and *Frameworks for Curriculum Development* take an important step toward shifting emphasis from instruction and assessment based primarily on "what students know" to a more balanced portrait of "what students know **AND** what they are able to

do" with their knowledge. Despite historical practice of compartmentalizing learning into subject areas, the *Standards* and *Frameworks* challenge educators to see subject areas within a broader context of what students must be able to do regardless of the subject area in which they are learning. These documents take a bold step toward integrating fundamental processes (i.e., gathering, analyzing and applying; communicating; problem solving; and decision making) and subject areas. With this shift, teachers throughout the system are going to be expected to begin seeing and communicating their subject areas not as separate compartments of knowledge but as interrelated pieces of an elaborate mosaic of knowledge and experiences.

Variations on an Interdisciplinary Design

There are several variations on the term *interdisciplinary*. Some people talk about *cross disciplinary* (viewing one subject area from the perspective of another, for example, the physics of music and the history of math, Meeth, 1978) while others use terms like *multidisciplinary* (the juxtaposition of several subject areas focused on one problem with no direct attempt to integrate, Meeth, 1978) or *pluridisciplinary* (the juxtaposition of subject areas assumed to be more or less related, e.g., math and physics, Piaget, 1972) or *transdisciplinary* (beyond the scope of the subject areas, i.e., to start with a problem and bring to bear knowledge from the subject areas, Meeth, 1978). All of the variations share a common thread of "viewing knowledge and curriculum in a way that consciously applies methodology and language from more than one subject area to examine a central theme, issue, problem, topic, or experience." (Hayes-Jacobs, 1989)

It might be useful to see the implementation of this definition as a continuum of options:



(Hayes-Jacobs, 1989)

Discipline-based

This is the option with which most educators are most familiar. Subject areas are neatly divided as units of time within the day, and content from one subject area is frequently separated from other subject areas—particularly in the higher grades. Taken to its extreme, this approach to curriculum, instruction and assessment even separates one area within a subject from other areas within the same subject—algebra from geometry, chemistry from biology, history from geography, etc. Educators nationwide are arguing against such a strict separation of knowledge. In other words, even at the level of traditional subject areas, educators across the curriculum are urging integration within their own subject areas. Integration at the level of the subject area has the dual advantage of being comfortable to teachers, students and parents and of being increasingly well supported by textbooks and other educational materials. Unfortunately, it also has the disadvantage of still fragmenting the day and fragmenting students' perception of knowledge and their ability to apply what they are learning in one subject area to situations, issues and problems encountered in other subject areas.

Parallel subject areas

In this option, teachers sequence their lessons to correspond to lessons in other subject areas. Examples come readily to mind: a history teacher who is planning a unit on World War II

coordinates her unit with an English teacher who is planning to teach *The Diary of Anne Frank;* or a mathematics teacher coordinates instruction in statistics and data analysis with another teachers' unit on polling and election practices. Probably the least difficult of the cross-subject options, parallel planning requires little more than communication among the faculty (something that can be admittedly difficult—particularly within secondary schools). Although it will expose students to multiple perspectives, such an approach neither makes the connections between the units of study explicit nor does it demonstrate for students the kind of collaborative inquiry and investigation that is possible in team-teaching and team-learning situations.

Multidisciplinary or complementary courses

Here the emphasis expands to drawing together units or courses that offer the student (and the faculty) opportunities to view a common content from multiple perspectives. Common examples are courses in which the emphasis shifts from content in a particular area to issues and/or themes that cut across several complementary subject areas, e.g., humanities programs or science-technology-society courses. This option affords a couple of advantages: teachers tend to be working with people in subject areas close to their own, and they have readily available support materials. On the other hand, planning these units or courses requires time, cooperation and the support of administrators, students and their parents.

Interdisciplinary units

In this option, teacher-designers bring together a full array of subject area perspectives; however, the emphasis is on supporting subject areas rather than replacing them. Such an organization has the two-fold advantage of making explicit the kinds of connections within and across the subject areas that were only implicit in the parallel organization, while simultaneously allowing teachers to retain subject area identity. The obvious disadvantage involves the time and commitment needed to plan and organize such a unit of study. Fortunately, however, since the unit is designed for a specific period of time, this option does not demand wholesale renovation of the school's organization; that is, the interdisciplinary unit is designed to work within existing course and/or time units.

Integrated day and complete program

Both of these options push (and possibly exceed) the boundaries of what is likely to be possible in many public school settings; however, many startling examples exist—particularly of the integrated day option. A nationally recognized high school in Arizona combined English, social studies, mathematics and science for an entire semester during which the students studied the economic and environmental impacts of a Corp of Engineer's dam and reservoir project being planned for the desert near their community. The students' work was so impressive that local media covered the students' final presentation. In another example, a Missouri elementary school combined all of its students in a semester-long project to create a colony on the planet Mars. In both integrated day and complete programs, the day is organized around student-generated questions.

The above continuum is not intended to suggest that being on the left of the continuum is bad or that being on the right of the continuum is good. Indeed, as any group of teachers who have experimented with the variety of forms that integration can take will testify, there are times when full-blown integrated projects are good for students, but there are also times when pulling back into a subject areas is absolutely necessary to student understanding. When seen

from a different perspective, however, the left side of the continuum does appear to be more teacher- (curriculum-) centered than does the right side. What is clearly of most importance is the learning of the student.

Who Can Be Involved in Curriculum Integration?

In a word, EVERYONE. Remember, integration is all about identifying commonalities or linkages. What tends to be common to all forms of integration is a desire to link the world of school with the world outside of school. Educators across the curriculum are exploring the many ways that their areas of expertise are used in the world. Efforts to integrate the curriculum can involve teachers and their students within historically related subject areas (mathematics and science; or communication arts and social studies; or social studies and fine arts); across the core (typically, mathematics, science, communication arts and social studies); across one or more of the core disciplines and vocational-technical education (for example, math-science-technology); across one or more of the core disciplines and one or more of the related arts (communication arts and foreign language, or science and home economics; science and physical education, etc.); across the core and vocational-technical education; and across all of the programs offered within the school.

The table below combines the Hayes-Jacobs continuum and the various combinations of teachers and disciplines. Some faculties have found this kind of presentation a useful tool in their early conversations about where they think they are and what they hope to accomplish as they build an integrated curriculum.

Pieces to be Integrated / INTEGRATION OPTION	INDIVIDUAL	PARALLEL	MULTI-DISCIPLINARY	INTERDISCIPLINARY	COMPLETE PROGRAMS
ACROSS SCHOOL AND REAL WORLD					
WITHIN A SINGLE DISCIPLINE					
ACROSS "LIKE" DISCIPLINE (e.g. math/science, English/History)					
ACROSS THE CORE					
ACROSS CORE AND VO-TECH					
OTHER					

Integration options based on Heidi Hayes-Jacobs' *Interdisciplinary Curriculum: Design and Implementation*, 1989

HOW DO WE GET STARTED? PART I

Essential Elements of Curriculum Integration: What Do We Need to Consider?

While each school's needs with regard to curriculum integration will vary, all schools would do well to plan for and keep in mind the importance of communication, scheduling, team building and administrative support as they begin the process of integrating the curriculum.

Communication

"If an integrated curriculum is as good as you say, then it will sell itself." Although good programs do tend to sell themselves, a communication plan is still necessary. Anytime a new idea is introduced into the school and the community, it must be "sold" to all those with interests in the students. The most important group of people to sell first are the people within the school—students, teachers, administrators and the local board. As students and teachers experience integrated curriculum, they will tend to promote the program to their colleagues—assuming that they are given the public opportunities to celebrate their successes. Once students and teachers have experienced and celebrated their successes, their enthusiasm can be harnessed outside of the school. Certainly a key group to engage are the parents of students—many of whom will not themselves have experienced integrated activities. Therefore, schools are expending extra effort to bring parents into the school to see the students' excitement and the authenticity of their projects. Other communities have enlisted parents (both as parents and as wage-earners) to help the school identify the ways in which the concepts students are learning are actually implemented in an adult's life. Either or both approaches will help parents see that the school is genuinely responsive to the students' needs.

Scheduling for Learning and Planning Time

Carroll (1994) contends that teachers cannot deal meaningfully with every student, every day under the traditional schedule. In a traditional six- (or seven-) period day in which instruction is scheduled in 40-50 minute blocks of time, a secondary student may be in nine locations pursuing nine different activities in a six-hour day. This schedule produces hectic and inefficient instructional environments. Not only may it prevent students from taking all of the courses that they want, but more importantly, it reduces flexibility for teachers to experiment with multidisciplinary or team-taught approaches and flexibility for students to engage in meaningful work or to seek meaningful assistance. Ultimately, a schedule should put into action a school's shared vision of its purpose, its curriculum and its decisions about student grouping and preferred teaching strategies (English, 1989). Even though there is no end to the number of ways a school can be scheduled and even though computers have simplified the technical problems of scheduling, the five- or six-period day remains despite many creative ideas. What persists is tradition. What then should or can a school do?

Conversation and decision making should precede any scheduling considerations. Once decisions about learning and teaching have been made, they should not be thwarted by the schedule. If, for example, a school identifies integrated curriculum and projects as a goal, then

it needs to explore scheduling models that will accommodate time for teachers to plan these activities and time for students to do their work. If a school identifies maximizing individualized instruction as a goal, it should explore scheduling and teaming options that will afford teachers more opportunity to work with students one-on-one or in small groups. In other words, the conversation should not be about whether the school should move to a "block schedule" or any of the other alternative scheduling models (see Dempsey or Fenwick for descriptions of nearly two dozen variations on schedules). The conversation should be about the relationship among time, learning and realizing the goals of the school and its students.

What are some benefits of alternative schedules (for example, block schedules)?

Alternative scheduling models change the way teachers and students use time. Teachers who have experienced schedules other than the traditional six- (or seven-) period day observe that they have more time to teach to the differing learning styles in their classrooms; that they experience fewer behavior problems; that the frequently longer class periods allow them to be more creative in their delivery; that they spend less time in administrative functions, such as taking attendance, setting up new activities, cleaning up for the next class, etc.; and that they have more energy at the end of the day.

Relative to their students, teachers (and students) who have acclimated to alternative scheduling models observe that students are better prepared for class; that they spend more time researching, discussing and teaming; that they spend less time moving to and from classes (or its correlate: that they have fewer opportunities to be tardy); that high school students are able to take more courses per year; and that all students tend to take a greater ownership in and responsibility for their learning.

What are some problems encountered with alternative schedules?

As impressive as alternative scheduling models may seem, all is not roses. Although longer class periods that meet fewer times per week may be effective for some subjects, not all subjects are best served by this arrangement; some classes need to meet with students the full year (for example, band). Teachers accustomed to thinking about instruction in 40-50 minute packages are rightfully concerned that they will need time to plan new activities and to experiment with a broader array of instructional strategies. Another problem arises out of student absences and the time needed to get the student caught up. Finally, teachers new to an alternative schedule sometimes express concern that they will not cover as much. In response to these kinds of problems, schools across the country are exploring and modifying scheduling to meet their particular curricular goals, thereby accommodating the needs of particular subject areas and particular kinds of students.

What can a school do to give a new schedule a fair chance of success?

Regardless of what scheduling option a school might select, it will quite probably represent a fairly substantial change for most teachers. Therefore, time to acclimate to the change and time to plan for new activities and potentially new roles and responsibilities is essential. Unfortunately, too many good experiments have fallen into disuse simply because the teachers involved couldn't find the time to work together. Although there is no simple answer to finding time, below are several ideas for making time:

- ***Giving teachers a full 90 minutes of shared time.*** An elementary school, for example, schedules teaching teams for the same daily lunch period followed directly by a common preparation period.

- ***Encouraging collaboration time for teachers.*** Some districts are rescheduling day-long staff development meetings in favor of shorter, but more regular and frequent, opportunities for teachers to work together. Refigured this way, five staff development days turns into 13 two-hour planning sessions. This would permit a two-hour collaboration time every two weeks throughout the school year.

- ***Converting instructional days into planning days.*** At a state level, Kentucky sought legislative permission to convert five of the required instructional days into staff development time. Texas sought authority to waive up to 15 instructional days to make them available for staff development.

- ***Arranging early arrival or release days.*** Many Missouri schools are already using these "early" days to provide teachers some planning time. The principal of one elementary school, for example, offered to dismiss classes 45 minutes early each Monday, Wednesday and Friday if teachers would extend the time by contributing 45 minutes of their own. In a Florida community, teachers and administrators agreed to extending the workday an hour to support their efforts in planning integrated curriculum.

- ***Lengthening the school day four days per week to allow for a planning day.*** One Rhode Island superintendent made Wednesdays teacher meeting days and persuaded local churches to hold their religious education programs on Wednesday afternoons. The superintendent also persuaded other youth activities to meet on Wednesday afternoons.

As teachers and administrators explore their options, they should keep a few guidelines in mind. Quantity of time is probably less important than the quality of that time. End-of-day planning time is frequently unproductive because everyone has already worked a whole day. Blocks of time are usually more effective than short bursts of planning. When planning is fragmented across the day, teachers spend more time figuring out where they were than in actually planning for where they want to be. Finally, a schedule must be created in light of district and/or state guidelines on such issues as required minutes (days) of instruction, maximum numbers of students that teachers encounter in a given day, etc.

Team-Building

Teaching teams in this context refers to collaborative teams of teachers. Teaming on the learning of students is about a more fundamental structure than the team-teaching that was popular in the 1960s and 1970s. According to Lounsbury (1992), team organization is defined by four characteristics: common planning time, shared students, common block of instructional time and common team space in adjacent classrooms and connecting hallways.

How can building teaching teams benefit students and the school? Teachers are better prepared to support one another's strengths and to accommodate one another's weaknesses. Therefore, teachers, as well as students, gain confidence in and knowledge of what is being taught. Teacher teaming supports integration in several ways. First, teachers' roles and relationships change from being isolated to being collaborative. Second, teachers learn to value each

other by mixing with and understanding the contributions made by each individual and by each subject area represented across the team. Third, membership on a teaching team helps teachers develop as professionals.

These same changes in teachers' relationships similarly benefit students. Students benefit from the richness brought by each team member; many students will comment on how their understanding of how adults work together was heightened by observing their teachers interact. Beyond the benefit in the role modeling provided by the teaching team, students also benefit from exposure to the variety of perspectives brought to a problem when experts from different subject areas all confront the same problem. Finally, students attest to feeling that they themselves feel like team members, thereby enhancing the sense of community so important to motivation and behavior management.

Administrative Support

In the absence of a shared understanding of the goals of integrating the curriculum and the level(s) of curriculum integration being sought, long-term success will be difficult. Initiating and sustaining integrated curriculum and instructional efforts typically require an actively involved leader at the building (and frequently the district) level. To many people, change doesn't come easy. Administrators must be aware of the terrible triplets of change: weary, leery and wary. Staff members may be weary of being taken out of their comfort zone for another "reform" effort, wary of the personal effects of change and leery of administrative motives for change.

While change may be welcomed by some, more often change causes concern and apprehension among staff members. Some teachers will welcome the integrated curriculum; others will fear loss of personal power. The instructional leader must empower teachers to change and must support their efforts in a risk-free manner. Beyond the very idea of change, some teachers will rightfully express concern about moving into content areas in which they feel insufficiently trained. Administrators are in the best position to help these people understand that integrating the curriculum (whether it is within a single subject area or across multiple subject areas) is not one person's job; rather, curriculum integration creates the opportunity to share expertise across a department, across a grade level and across a faculty. Administrators must also develop trust among their faculty. The administrator must set a democratic tone in which teachers feel their voices can make a difference. Only then can teachers express and resolve their fears and concerns.

Models for Curriculum Organization: How Can We Organize Ourselves and the Curriculum?

There are possibly as many ways to deliver an integrated curriculum as there are forms of integrated curriculum. From thematic units to applied courses, teachers have a wide variety of options available within which to package their ideas. This section will outline several delivery structures. Some of them will seem more applicable to one grade range than other (elementary schools or high schools); some will enter the picture from the academic side, while others will enter from the vocational side. Some will seem to require major changes in the way a school is organized, while others will seem to require fairly minor shifts in teachers' thinking about curriculum, instruction and assessment. Regardless of the particular kind of integrated curriculum or its particular orientation, integration in its simplest form has the potential to support sound teaching practice—making abstract concepts more understandable by applying

them to real-life situations. In this way, integrated curriculum exhibits potential to reinforce students' acquisition of basic and higher-order academic skills, to enhance the rigor and completeness of occupational skill training, and to renew the way in which both academic and vocational education are delivered.

Thematic Units

All of the models discussed below share several features:

- Developing the skills, knowledge, and attitudes necessary for students to achieve success in school, in the work force, and in their lives as responsible and productive citizens.
- Incorporating active or applied learning.
- Organizing curriculum around big ideas; or said another way, learning from whole to part.
- Basing curriculum on connections and teaching students how to learn.
- Embedding learning within real-world contexts.

Thematic units are probably the organizing device best known to teachers, particularly those in traditional elementary/middle education and secondary subjects. Theme is used here as a merely generic term for any title, topic, concept, issue or problem that is used as the unifying focus for study. Themes can be drawn from any perspective across the curriculum. Regardless of the theme's source within the curriculum, a really useful theme will be broad enough to contain several contexts, concepts or topics. Where themes have enduring value, topics are frequently grounded in a particular moment in time or in a particular context. Justice, for example, is a theme, within which students might explore several specific legal issues or several specific kinds of justice. Systems is similarly a theme large enough to contain mechanical systems in engineering (that is, force, motion and mechanical energy in science), transportation systems in discrete mathematics, and linguistic systems in the communication arts curriculum. If a goal of integrating the curriculum is to help students see how the parts fit within the big picture, then themes selected for study must be sufficiently large enough to contain those different perspectives.

Mental Processes

A variation on the "big ideas" approach (Rutherford & Alhgren, 1990) suggested by "themes" as an organizer is one in which the focus of learning is on mental processes, for example, classification/division or comparison/contrast. As with the themes, these processes cut across disciplines. For example, most subject areas use classification and division as a building block for thinking: chemistry has the periodic table, botany has phyla; mathematics requires sorting and grouping; literature has genres. All of these ways of structuring knowledge require the mental act of classifying and dividing; each subject area may, however, have slightly different ways of using the process.

Consider the variety of reasoning processes that might be used to organize curriculum: comparing, classifying, inducing/deducing, analyzing errors, constructing support, abstracting and analyzing perspectives. Not surprisingly, these are the kinds of cross-curricular mental activities expressed in the Show-Me Standards. Since these processes are so universal, they are

not only vital to student success across the curriculum, but they are also points where the curriculum naturally intersects. Through a focus on similarity and difference across the subject areas, students simultaneously gain a deeper understanding of the ways in which knowledge is constructed and used in a variety of contexts.

Curriculum Blocks

Thematic units and mental processes might be usefully seen as representing opposing axes of a grid. That is, if "justice" were identified as a theme, then the theme could be matched to mental processes through which students would explore the theme. For example, within the broad theme of justice, students might explore the American legal system. To help them develop a deeper understanding of the American legal system, they might study the American system through comparing it to the French system or the English system. In this example, the instructional goal is two-fold: one involves a desire for students to develop a deep understanding of the way the legal system works in America; the other involves a desire for students to develop a deep understanding of how knowledge can be organized to give it meaning.

As important as integrating knowledge and process is for students' learning, it is not sufficient to meeting the needs of students. When, however, one adds purpose or meaningfulness to those intersection points, the subject matter (both content and mental process) comes alive. One way to give content choices purpose (meaning, context) is to be found in curriculum blocks (Ahlgren & Kesidou, pp. 44-54). Those working on the Project 2061 national science project identified four distinct purposes within which students conduct their study; although the 2061 work originates in science, the following purposes can serve equally well across the curriculum: "finding out about how something in particular in the world works," "solving a practical problem," "reflecting on some enduring human concern," and "learning about how we know what we know."

As described by the authors, these purposes "provide a vision of the ways literate people use knowledge and skills." In short, posing students with one of these purposes as the context for their study of content and mental processes will help them answer the age-old question, "What am I supposed to do with this information?" Obviously, these are not the only four ways to contextualize students' study. Another model for establishing context for study focuses on issues analysis, decision making and problem solving as ways to contextualize study. (See the "How Do We Get Started? Part II" section for discussion of two process models that teachers have found useful.)

Applied Academics

Developing and/or implementing applied academics courses is perhaps one of the most common ways to integrate curriculum, especially in high schools. These courses teach traditional material in a contextual manner, attempting to help more students successfully learn the material by bringing the "real world" into the classroom.

In "Helping Teachers to Understand Their Roles in Integrating Vocational and Academic Education," a field study in which over 100 teachers, counselors, principals and administrators in ten schools were interviewed about integration, Schmidt, et al. (1992), write that academic teachers were "particularly excited about approaching instruction through application or use of hands-on learning." They explain that these teachers think their teaching more effective when

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done in an applied manner, citing such examples as a science teacher who now shows students how they will use the concepts he teaches in experiments before introducing the concepts themselves and of an auto mechanics teacher who teaches safety rules by having students write a business letter as a representative of an insurance company who has found safety violations in an auto repair business. The authors conclude that "for the applied approach to be successful, teachers must also learn to assess the outcomes of the new instruction carefully and to use applied approaches only when effective." (p. 13)

Some teachers have expressed concern that students taking applied courses will have trouble with college transcript analyses. In response to that concern, the Missouri Department of Elementary and Secondary Education has for some time been working with the state's Coordinating Board for Higher Education and the University of Missouri in certifying applied courses. Their joint efforts have, for example, resulted in the University of Missouri accepting "Principles of Technology I & II" as equivalent to a physics course. College admissions officers in this and other states are quick to assert their eagerness to work with schools and their students in the admissions process. For more information about a college's willingness to accept applied courses, contact the institution's admissions office. Another source of information would be the Department of Elementary and Secondary Education, Division of Vocational and Adult Education.

Several courses in applied academics have been developed in recent years. Applied Mathematics, Applied Biology and Chemistry, Applied Communications and Principles of Technology are already being implemented in high schools statewide. For more information about these and other materials, contact the Agency for Instructional Technology (Box A, Bloomington, IN 47402; 1-800-457-4509) or the Center for Occupational Research and Development (601 Lake Air Drive, Waco, TX 76702-1689; 1-800-2311-3015). Missouri is a member of the consortium that developed these AIT and CORD materials, so substantial product discounts are available to Missouri educators.

Career Paths

Career paths are clusters of occupations/careers that are grouped because many of the people in them share similar interests and strengths. Many Missouri schools are using the following six career paths as a way to help students explore and prepare for their options: arts and communication; business, management and technology; health services; human services; industrial and engineering technology; and natural resources. Since each path includes a variety of occupations that require different levels of education and training, all students can use career paths to prepare for their future, regardless of their interests, abilities, talents or desired levels of education.

By understanding and exploring a career path, a student gains an area of focus into which he or she can begin directing energy. The career path can help guide in course selection, participation in work-place readiness programs like cooperative education and tech prep, selection of extra- and co-curricular activities, and even part-time employment for older students. However, because the student selects a career path containing many occupations instead of selecting a particular occupation, the student retains the flexibility to explore different occupations and to participate in a variety of learning opportunities.

An important thing to remember about career paths is that they are not based on specific jobs; rather they are categories of occupations that cluster around a central theme within which are many occupations, each requiring different amounts and kinds of secondary and post-

secondary education. The implication of career paths for students is that rather than schools making decisions for students, students (and their families) make decisions for themselves. From earlier grades, students would have learned about their options within each path; therefore, a student could exit a path and re-enter at a later time for additional education. For example, a student might embark on the health services path while still in high school intending to pursue a career in nursing. After high school graduation and upon completion of a post-secondary nursing program and working in the field for a while, the student might later decide to re-enter the path and pursue a medical degree, which could result in the highest levels of medical research. On the other hand, this same student might begin in the health services path and later decide to alter his or her course a bit to focus on a career in a social service agency. Although the student would need to back up a bit to enter the new path, the solid grounding in eleventh- and twelfth-grade would ease the transition considerably. The point is that building a curriculum with a career path focus provides students the tools to make informed decisions well beyond their time in the public schools.

On a smaller scale, career paths can also be a useful organizer for teachers seeking a context around which to build integrated courses and individual units within existing courses. In that career paths are based in the real world, they automatically provide countless opportunities for contextualizing students' experiences with the curriculum at all grades.

At the course level, ninth- and tenth-grade teachers might consider freshman/sophomore career exploration seminars. Given the six paths, teachers might divide the year into six major units of instruction, each built around a project appropriate to a particular path. Early in the year, planners might focus on the Arts and Communication Path, engaging students in creating multi-media entertainment programming that might result in presentations at the ninth- or tenth-grade fall party. Later in the year when students have developed more mathematics skills, planners might focus on the Industrial and Engineering Technology Path, engaging students in designing and modeling an energy-efficient home for presentation to area architects and contractors.

At the unit level, teachers within and across the subject areas can identify topics embedded within a path. For example, a high school chemistry unit might focus on the Health Services Path by studying forensic science; students might be engaged in collecting and analyzing evidence to solve a fictional criminal case. Rather than studying blood chemistry for the sake of passing the test, students engaged in solving a crime now have a specific context within which to conduct their investigation and a goal (product) toward which to focus their attention. Career paths are not just for high school students however. A fourth-grade social studies/science/communications unit might focus on the Natural Resources Path, engaging students in an environmental study that is part of the regular curriculum; that is, fourth-graders across the state frequently study Missouri at some point during the year. Rather than studying ecosystems for the sake of studying them, students might now be engaged in planning an educational program for younger children about the ecosystems present in a local park, an activity well within both the purview of someone working within the Natural Resources Path and the regular curriculum. In either example, adding information about the path serves to heighten the sense of reality for the students.

The National Center for Research in Vocational Education (NCRVE) Models

These eight models emerge from a vocational orientation; that is, their originators (Grubb, et al., 1991) start from the assertion that vocational education must have a broader

purpose and focus in the future. They observe that vocational education can serve as a delivery system in which various subject areas blend and interrelate into an integrated and comprehensive education program that emphasizes higher-order thinking and problem solving skills. "By utilizing a variety of approaches, such as cooperative learning, applied instructional strategies, problem solving and experimentation, this new integrated instructional system will help students learn how to learn." (Grubb, 1991) Since these models emerge from a vocational education orientation, they are also not surprisingly focused on secondary school since the majority of vocational education has traditionally occurred at the upper grade levels; however, the ideas embodied in these models are being implemented at all levels of education—from elementary to post-secondary. On one scale or another, high schools across the state are exploring how to infuse career path awareness into their existing curriculum and structure, especially those involved in the A+ Schools Program. For sake of space, the following discussion collapses the eight models into two discussions.

Models 1-4: Integrating Academic and Vocational Competencies

In these models, vocational educators incorporate more academic material into existing vocational courses; academic educators incorporate more occupationally relevant material into academic courses (for example, see "applied courses" above); or working together, academic and vocational educators combine elements from each other's curriculum and then link the two. In this last situation, two or more teachers, from both the academic and the vocational sides, coordinate the content of what they teach at a particular time (see earlier discussion of "parallel planning"). This kind of alignment is sometimes referred to as "horizontal alignment" (as opposed to the more common notion of "vertical alignment"). In the best cases, this practice creates sequences of academic and vocational courses that reinforce each other, thereby clarifying that integrating academic and vocational education is an activity that can consider entire programs rather than just individual courses. Regardless of the alternative chosen by a school, students are the beneficiaries: vocational students acquire deeper conceptual understanding required by industry, and academic students develop the skills necessary to applying abstract concepts to real problems.

Models 5-8: Academy, Magnet and Occupational Majors Models

Academies are schools-within-schools that typically combine academic teachers in English, mathematics and science with a vocational instructor in a subject like health, electronics, robotics, business or agriculture. Magnets are typically schools focused on one or more occupations or broad themes. In some cities (for example, New York, St. Louis, Kansas City), single-occupation middle and high schools have developed; some of the more famous examples include the New York City for the Performing Arts and its counterpart in Los Angeles, both of which have been highlighted in the national media. Both academy and magnet models provide an obvious focus for efforts to integrate academic and vocational education and a culture in which the occupational content of coursework cannot be ignored. Beyond the opportunities for integrating curriculum, these models also afford opportunities to establish close working relationships among faculty, between faculty and students, and between schools and partnering business. Moreover, these organizations also combine students from different backgrounds with very different occupational ambitions, thereby reducing segregation of college-bound and vocational students—a clear advantage to promoting democratic education and communicating to students and parents that the school has high expectations for all students.

HOW DO WE GET STARTED? PART II

Developing Integrated Units of Study

This section describes activities necessary to planning integrated units of study. Below is first the list of activities. After the listing, each one is discussed. After the discussion appear two models for teachers to follow that incorporate most of the activities. Finally, the listing of activities is presented as a checklist for assessing the integrated project, unit, or activity.

Although the activities appear as steps in a process, they are really intended as checkpoints along a path. That is, some teachers will find starting with the student product more logical for them; others will find starting with curriculum objectives more logical for them. Where a team of teachers (or even the individual teacher in the case of integration within a single person's subject area/classroom) starts is less important than whether the team considers all of the issues discussed.

A second observation about the activities is that planners must think of each step as representing a preliminary rather than a final decision made. For example, although a team might have decided to have students use a particular software package to do their work, later on when that package becomes unavailable, the team must be willing to go back and readjust their thinking. In other words, planners must be flexible and willing to alter plans both as they plan and as they implement the unit.

The following activities are necessary in developing integrated curriculum units:

- Brainstorming, evaluating and selecting a concept, theme or project.
- Identifying an authentic and/or age-appropriate context in which to set the unit.
- Preliminarily identifying the culminating performance, demonstration, exhibition, etc., upon which the students will be assessed.
- Articulating a small number of focus questions that will guide and set limits upon the project/unit.
- Selecting a primary Show-Me performance (process) standard and secondary (i.e., contributing) standards; similarly, selecting primary and contributing Show-Me knowledge (content) standards for the unit to address (sources: *Show-Me Standards, Frameworks*; local curricula; national content standards documents in the subject areas).
- Creating and sequencing activities (large group, small group, individual) to teach content and processes.
- Identifying what resources will be needed, which are available, and which will need to be acquired.
- Identifying and/or creating assessment tools (observation checklists, answer keys, rubrics, etc.) and appropriate evaluation criteria for use with each activity and the culminating performance

Activity-By-Activity Discussion

Brainstorming, evaluating and selecting a concept, theme or project.

Once a planning team has decided to collaborate on a common unit of material (whether the teachers see themselves working in parallel or as an interdisciplinary team), they have just begun. Now they face the task of deciding what subject areas they wish to integrate, what overriding concept and theme will unify the unit of study and what role(s) each teacher will have in the plan.

Throughout the professional and popular literature appear countless examples of innovative units, courses and entire academic programs that are designed to cut across subject area boundaries and simultaneously to change teachers' (and their students') focus from the transmission, acquisition and storage of bits of information to in-depth exploration of a fewer number of "big ideas." From science programs that integrate the humanities to mathematics units that use modeling to study population growth, teachers across the curriculum and across the grade-levels are exploring ways to integrate their individual subject areas to help students study meaningful subjects, issues and problems.

In but one example, James Banks (1991) calls for a seminar approach to social studies in which he proposes that "the issues selected for study be ones that have been of concern to humans in the past, that are of concern today and that will be important concerns in the future." He identifies the following themes: the quest for freedom; leadership and social change; the development, use and control of technology; immigration, migration and population change; peoplehood, cultural identity and nationalism; magic, science and religion; the quest for explanations; and cooperation and conflict in human societies. Although conceived through a social studies lens, Banks' list not only addresses his concern that themes have enduring importance, but also that a theme must provide opportunities to integrate a variety of curricula.

For another example, a middle school (grades 6-8) has identified the following big themes for cycling through their instruction that focus on integrating science, mathematics and technology.

1. **Systems and Interaction.** A system can be defined as an interacting group of forces, bodies, or substances or as any collection of things that have some influence over one another and appear to constitute a unified whole. How the systems interact gives vital information about the individual components of the system being studied. Any part of a system can be considered as a system or subsystem, with its own interactions and internal parts.

2. **Stability (equilibrium, conservation, symmetry).** This theme relates to analyzing ways in which systems do not change or studying the constancy within a system. Stability also relates to the repeatability of results in science and the ability to derive laws.

3. **Patterns of Change (trends, cycles, random and unpredictable changes).** Change through time can be analyzed in connection to its rates and patterns. Knowing different patterns of change provides students with an understanding of natural systems and their underlying mechanisms and can help them predict future actions. There are three general categories of change: trends (steady, predictable changes); cycles (occurring in a sequence that happens over and over); and unpredictable (changes that appear to be random or so complicated as to have apparently chaotic results).

4. **Scale and Structure.** Structure emphasizes the relationship among different structures, for example, how matter, a system or a process fit together; structure is also related to function and scale. Scale defines the focus of the relationship; determines the level at which this structure is examined; concerns the range, comparison and measurement of various magnitudes, such as sizes, speeds, distances, amounts, or lengths of time. Scale and structure provide a means for understanding the underlying framework that gives order to matter.

5. **Energy.** Energy—a central concept of the physical sciences that pervades the biological and geological sciences as well—is the ability of an object to change itself or its surroundings, the capacity to do work, the ability to put matter into motion. Thematically, energy connects all subject areas. Energy sources are crucial in the interactions among science, technology and society.

6. **Temporal Development.** This theme can be broadly described as change over time, thus representing the idea that the present arises from the past. Change is a progression of simple alterations over the continuum of time. The entire universe and all of its inhabitants can thus be studied from the viewpoint of historical change. This theme can be used to understand why things exist as they do today by understanding how they were in the past.

Pitfalls planning teams should try to avoid. Both Banks' themes and the math-science-technology themes are indeed "big ideas"—so big in fact that they might intimidate those looking for a more modest starting point; they do, however, afford an opportunity to consider a couple of the pitfalls that interdisciplinary planning teams should try to avoid.

Common to most examples of interdisciplinary approaches is the two-fold concern that the theme or project be meaningful to students and that it be explicitly connected to the curriculum. Given the realities of time, resources and district/state-mandated curricula, teachers need to focus on those themes or projects that will directly enhance and support the curriculum rather than those that will require additional work. Most teachers have experienced the planning session in which someone proposes an idea and then each teacher in turn brainstorms some way in which his or her subject area could be adapted to accommodate the idea. The question should usually not be how can my subject area contribute to this theme or project, but rather, *should* my subject area contribute to the theme or project? In other words, in planning integrated projects or units, teachers from each involved subject area should ask whether the proposed theme or project will serve as a vehicle for significant learning that will occur within the curriculum rather than as something added to the curriculum. The point is to create a unit of study that will afford students the opportunity to study concepts in depth, thereby enhancing their understanding across all levels of cognition—from recall and recognition to analysis to synthesis, extrapolation and evaluation.

To help address the first concern that the interdisciplinary proposal be meaningful to students, planners should ask the following kinds of questions. What is so important about this theme/project that it will promote future learning? Does it have substance and application? Are relevant materials readily available? Is it meaningful and age-appropriate? Does it tie into other units, enabling students to make generalizations and have greater understanding? Is it worth the time needed to create and implement it? ("Choosing a Theme," 1992)

Assuming that the proposed theme (or a revision of it) survives this first inquiry, teams should also ask these more specifically validity-related questions to evaluate the proposed

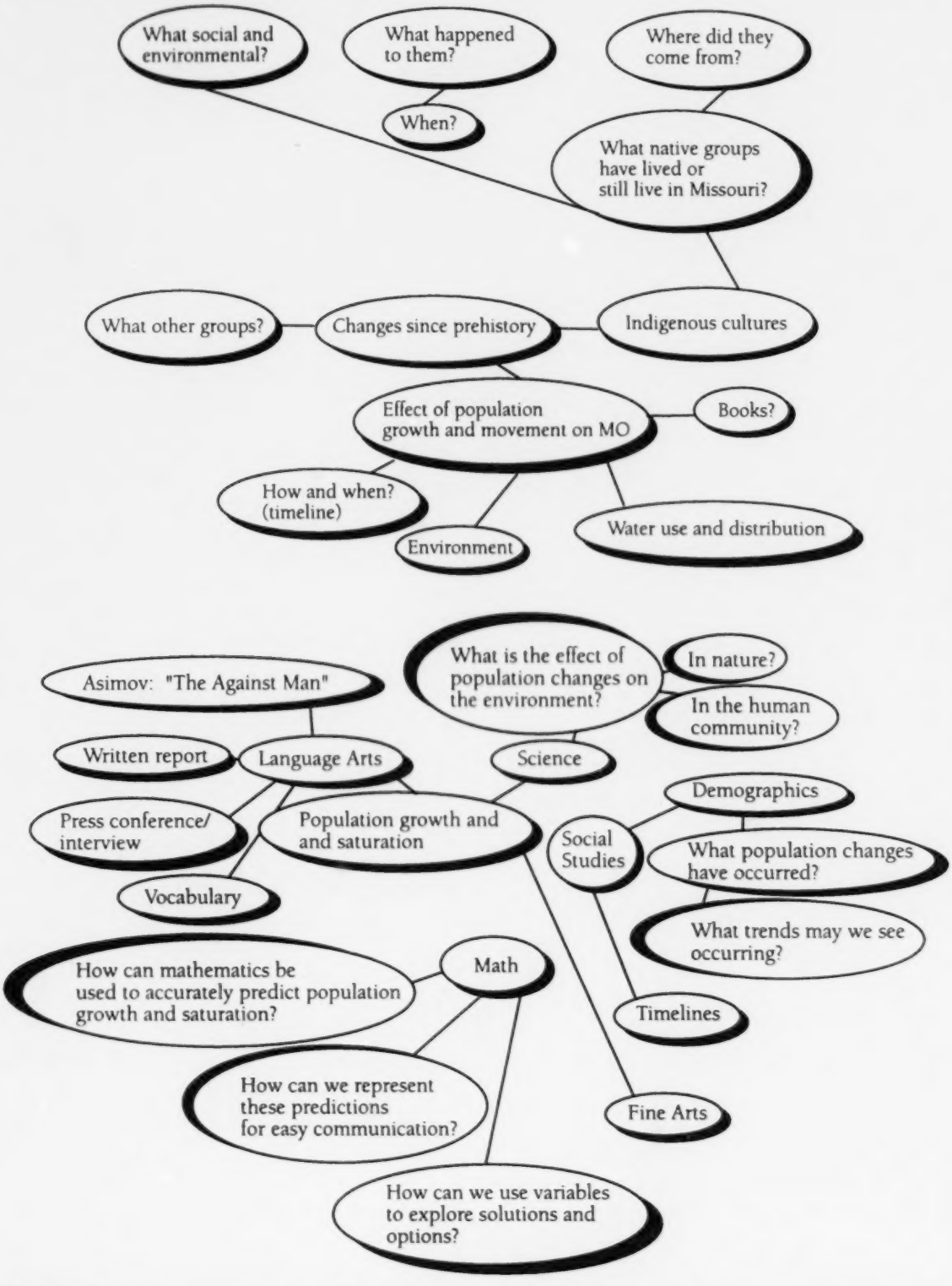
theme's significance to the current curriculum. Is the theme embedded within the current curriculum? Will the theme allow each member of the team to teach required content? Will the theme, however interesting it might be, require team members to squeeze it in amidst an already overloaded curriculum?

In that integrated instruction offers enormous potential to "help shape the learner's overall approach to knowledge" (Ackerman, 1989), planners should honestly evaluate the theme's potential not only to involve the subject areas in substantial ways but also to occasion analysis of each subject areas' contribution to study of the theme. Planners should, therefore, determine that the theme does in fact apply broadly to all areas/subject areas involved, that it reveals fundamental patterns of thinking, problem solving, etc., and that it reveals contrasts and similarities across the involved subject areas.

As part of the theme planning and evaluation process, planners should take time to articulate in specific terms how the perspective of each represented subject area will legitimately inform study of the proposed theme. Some perspectives will be obvious to the theme; others will require some imagination and creativity. Regardless, however, two points should guide the perspective:

- the perspective should not be forced just to include another subject area in the plan; and
- the perspective should become evident and relevant to the students.

Graphic organizers such as spoked wheels or Venn diagrams are effective ways to visualize the contributions and perspectives of each subject area. The following "web" diagrams show one team's exploration and gradual narrowing of a concept related to desert ecosystems.


What social and environmental?
What happened to them?
Where did they come from?
When?
What native groups have lived or still live in Missouri?
What other groups?
Changes since prehistory
Indigenous cultures
Effect of population growth and movement on MO
Books?
How and when? (timeline)
Environment
Water use and distribution
What is the effect of population changes on the environment?
In nature?
In the human community?
Asimov: "The Against Man"
Written report
Language Arts
Science
Press conference/ interview
Population growth and and saturation
Vocabulary
Demographics
Social Studies
What population changes have occurred?
What trends may we see occurring?
How can mathematics be used to accurately predict population growth and saturation?
Math
Timelines
How can we represent these predictions for easy communication?
Fine Arts
How can we use variables to explore solutions and options?

Reprinted with permission by citation. Foster, B.F., and Walker, M.L. (1993). "Planning and Implementing Interdisciplinary Units: A Workshop." Columbia, MO: Educational Development Project.

Identifying an authentic and/or age-appropriate context in which to set the unit; that is, adding authenticity to the theme.

Once teachers have determined that their proposed theme is appropriate to the students and the curriculum, they should turn their attention to embedding that theme within a context that will enhance its connection to the real worlds of our students.

Scenarios and Contexts. Central to many of the design characteristics of performance-based instructional and assessment materials is the creation of a rich context within which students assume roles, conduct their investigations and communicate their findings. Context and scenario are interrelated concepts which help define each other. During the development of performance-based activities, developers must carefully consider both elements.

Context refers to the whole situation, background or environment within which an event, activity, creation, etc., occurs. It is essentially like the setting of a play; examples include such "places" as a newspaper city desk, a trial, a deserted island, an activist meeting. The context determines the motivations, background, stimuli and interpersonal dynamics of the action.

For example, if the action occurs within a newsroom, the people populating that newsroom will probably be reporting on current and relevant historical events, as well as editorializing about issues. They will probably need to do research, especially interviews, in order to inform their reports and editorials. They will necessarily be involved in writing for the public, creating graphic visual aides and perhaps drawing cartoons or other visual communications. They are probably interested in the views and interests of their reading public and will weigh their editorial decisions against the reality of their particular audience.

Scenarios work within the context; that is, a scenario is the plot played out against the background provided by the context. The author creates the scenario, including specific, logically integrated and sequenced actions leading from a point in time or a specific stimulus to a reasonable conclusion. All steps within a scenario should be appropriate within the context.

Using the newsroom context again, an event or issue (for example, a proposal to construct a nuclear power plant within the community, an oil spill on the river, an upcoming election, a community-based historic preservation project, a housing design problem, creating an itinerary for an international tour group, etc.) will trigger a series of activities. These may include a meeting of reporters and editors, discussion of the interests and needs of the newspaper's readers, assignment of story topics, determination of lead stories, creation of graphics and cartoons, research for definitions, polls to determine public opinion, interviews to get expert information, perhaps a single story or editorial, perhaps an entire issue. In any case, the beginning is a common stimulus; the ensuing activities are events that would realistically go on within the context; and the entire process leads to a climatic event or activity relevant to the context.

This step should also include decisions regarding how the involved teachers will implement the theme; that is, will they operate in parallel or will they operate as a multi- or interdisciplinary team?

Preliminarily identifying the culminating performance, demonstration, exhibition, etc., upon which the students will be assessed; that is, giving students something real to create.

Performance-based instruction tends to be goal oriented; that is, students are not only posed with a problem or an issue for study, but they are also directed (and guided) to produce something significant and meaningful as the demonstration of their knowledge and abilities. The following is but a brief list of the wide range of possible climactic events toward which students could be directed, any of which would lead students to apply and demonstrate what they are learning: mock trials (for example, putting an historical figure "on trial"); juries (for example, an art jury); demonstrations/exhibitions (for example, a science fair); performances (for example, a theatrical performance, a puppet show, etc.); debates; peer instruction (for example, teaching students in a younger age group about home safety); citizen actions (for example, initiative petition, lobbying activity, etc.); class publication(s) (for example, a classbook on an historical period or a scientific discovery); press conferences/news releases; proposals (for example, for school expenditures, for a party; for civic projects; etc.); various kinds of impact statements (for example, environmental, economic, etc.). For additional ideas of products and performances, see Appendix B in the Communication Arts Framework.

Yet another approach to identifying a real-world application of what planners want students to learn can be found in the six Career Paths. Within each path are many occupations that suggest culminating performances (and contexts) for projects. For example, within the Arts and Communication Path are such occupations as interpreter/translator, technical writer, musician, director/producer, photographer, camera operator, etc. A culminating performance within this path might involve students in creating a multimedia music performance for an upcoming school party. Students would need to script the presentation, film (videotape) it, coordinate images and music, etc. Under the Industrial and Engineering Technology Path fall such occupations as construction-related trades, engineering, architecture, etc. With this path in mind, students might create three-dimensional models of energy-efficient homes for their climate zone. For more information on Career Paths, see the earlier section on "Models for Curriculum Organization" (p. 14).

In short, teachers have available countless sources for providing contexts and products that will connect school to the real world. Whatever planners (or students) ultimately select, it must be a logical outgrowth of the context and scenario. The culmination of such an instructional practice is rarely a test in the traditional sense, and indeed much of what students might produce might not even be "paper-and-pencil." Planners should keep in mind that very little of the student's life will be devoted to taking paper-and-pencil tests; on the other hand, much of the student's life will be spent in writing reports, in constructing three-dimensional (or computer) models, in solving problems and implementing solutions, in arguing cases, etc. Therefore, if one of our goals is to narrow the gap between instruction and the real world, we must similarly narrow the gap between how we assess student knowledge and ability and how the adult world will assess them in the future.

Articulating a small number of focus questions that will guide and set limits upon the project/unit.

One of the often-confronted problems with integrated team planning is the tendency for units to mushroom in size and complexity. Developing focus questions is good way for planners to set boundaries around what they want students to learn from the unit. A sample unit on designing an energy-efficient desert home might yield the following guiding questions: "what forms does energy take?" (science and mathematics focus); "how can energy be stored?" (tech-

nical and vocational education, in addition to hands-on science and mathematics); "what forms of shelter have various desert cultures used over the years?" (social studies and communication arts); etc. These questions could be distributed to students at the outset and used by individuals and/or groups of students to structure and pace their investigation.

Selecting a primary Show-Me performance (process) standard and secondary (i.e., contributing) standards; similarly, selecting primary and contributing Show-Me knowledge (content) standards for the unit to address; that is, determining instructional validity.

The *Show-Me Standards* provide a ready means for identifying the kinds of activity in which students might be engaged. For example, standard 3 in Goal 1 (gathering, analyzing and applying information) requires students to "design and conduct field and laboratory investigations." Such a statement could well represent the "objective" for an entire unit or for an activity within a unit. For example, a project/unit might require students to create a marketing campaign for the best kind of coat to keep one warm in Missouri's winter. Students would be required to come up with their own hypothesis to test (for example, goose down keeps one warmer than cotton-fill); a way of testing the hypothesis; a way to evaluate the information resulting from their experiments; and finally a way to communicate that information in the marketing campaign (see standard 2.1). Therefore, the primary process standard focus might be the student's ability to "design and conduct a laboratory investigation" (1.3); secondary (or contributing) standards (also coming from the *Show-Me Standards*) might be the student's ability to "organize data in useful forms for analysis or presentation" (1.8), the ability to "plan and make written, oral and visual presentations for a variety of purposes and audiences" (2.1), and the ability to "assess the potential costs and consequences of proposed or attempted solutions" (3.8).

The content standards provide another source of information for identifying specific connections to the curriculum. For the above example of creating a marketing campaign for winter coats, students would be exhibiting their understanding of the "processes of scientific inquiry" and the "properties and principles of matter and energy" (science standards 7 and 1) and their understanding of research and presentation techniques (communication arts standards 1, 3, 4 and 6). Planners could use this strategy to document (that is, to validate, and ultimately to report) the *Show-Me Standards* that the unit is designed to teach.

The point here for planners is to identify a few specific curriculum points that the unit will be expected to teach. Again, the tendency for teachers is to see everything that a unit *could* teach. Teachers must resist this tendency and focus on those specific items within their curriculum that the unit *must* teach and that students must understand. Ultimately, teachers must be able to document (for themselves, for their students and their parents, for school administrators) what the students are learning. As teachers move toward increasingly integrated units of study, their need for careful documentation of what curriculum has been taught, what needs to be retaught, what does not need to be retaught, etc., becomes increasingly acute. Without this kind of thoughtful accounting of each person's curriculum, the team runs the risk of not knowing where it has been, where it is and where it needs to go next.

Creating and sequencing activities (large group, small group, individual) to teach content and processes.

In adult life, the boss may not provide some framework within which an employee is expected to solve a problem. The goals of school are different, however; we are trying to teach

students **how** to solve problems. For this reason, planners should give careful consideration to the kind of scaffolding they provide students (see discussion of scaffolding and modeling on page 35). Identifying appropriate activities that will lead students to successful completion of a project and carefully considering the range of cognitive activity required by each activity will usually lead to more complex learning and greater student success. If, for example, most activities within the unit call for students to recognize or remember rules, key facts, concepts, definitions, etc., then the unit and the resultant learning cannot be expected to get beyond low levels of comprehension. At the other end of the spectrum, if all activities require students to judge quality or to evaluate worth, the unit is probably overlooking fundamental skills in its zeal to teach higher-order thinking skills of synthesis and evaluation.

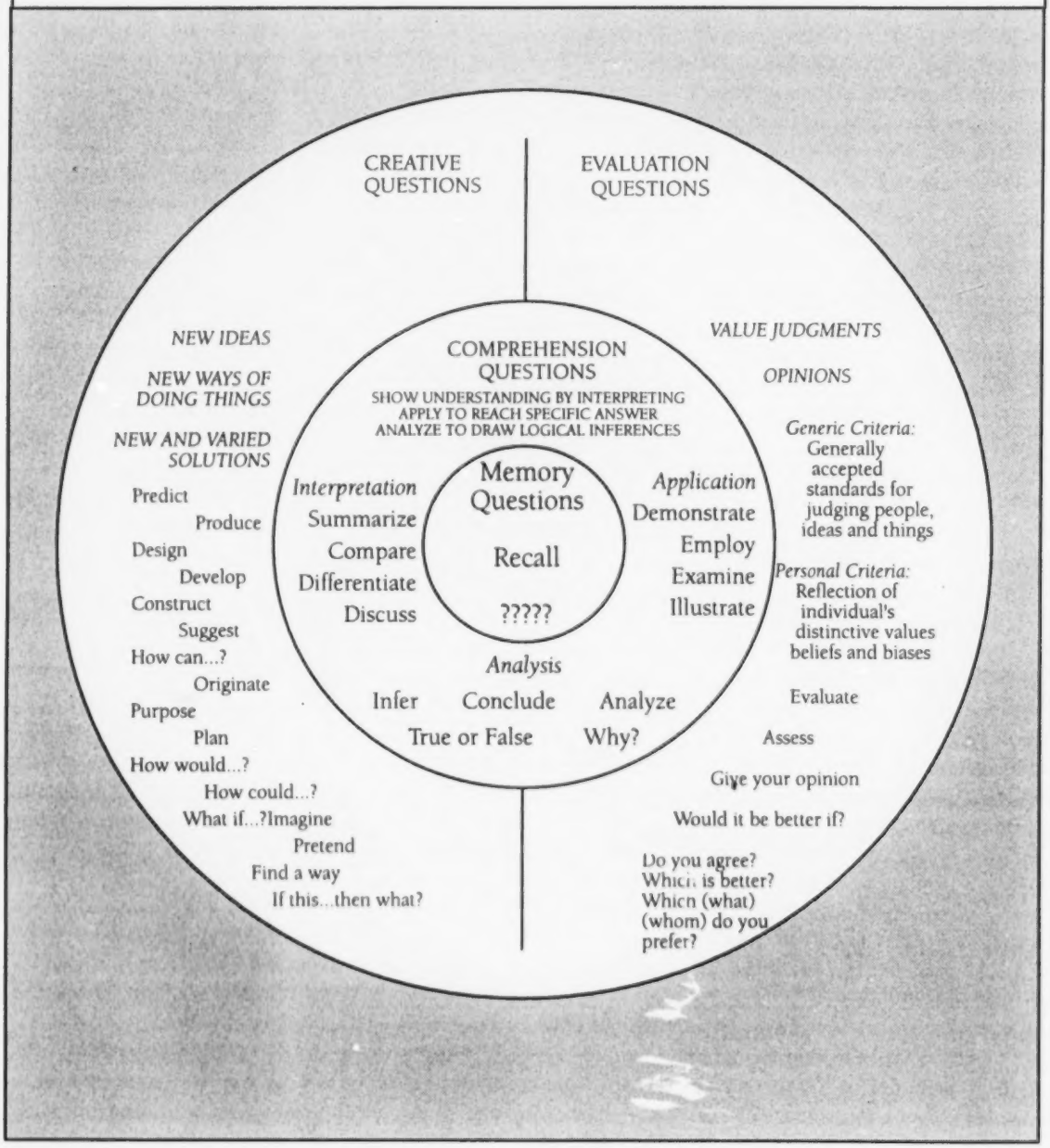
Three practices will help planners to sequence activities:

- Frequent reference to cognitive taxonomies, for example, Bloom, Hannah-Michaelis, etc.,
- Careful (and honest) attention to the verbs used to describe and direct the activities (for example, recall, apply, analyze, compare, evaluate, etc.) (see the circle diagram for "Creative Thinking" below), and
- Frequent checks to ensure that the activities students are being asking to perform are realistic and logically necessary to the overall theme.

Planners should also remember to include frequent opportunities for students to examine (and report) what they are learning, how they are solving the problem, etc. Familiar devices, such as learning logs, journals and class discussions, can be appropriate mechanisms for capturing (and later evaluating) this kind of information. (See page 37 for a discussion of the important role that reflection and articulation play in learning.)

The graphic on the following page (Hampton, 1994) provides a visual representation of thinking skills. In many cases, teachers will be able to align language in the Show-Me Standards with items in the middle and outer circles.

CRITICAL THINKING



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Identifying what resources will be needed, which are available, and which will need to be acquired.

Planners should remember to enlist the assistance of their building's library and media specialist(s) as they are planning activities and identifying resources. When the unit calls for research activities, planners should remember to alert (and cooperate with) library/media center staff to facilitate these activities. In addition to the practical matters of identifying and coordinating resources and services, planners should be alert to a broad range of research activities that support information literacy. Similarly, planners should think carefully about the "equipment" needs for other areas of a project; for example, if the project/unit will require students to conduct a multi-day science experiment (for example, something involving growth in plants), the science department will need to be able to support the equipment and storage needs of potentially large numbers of student experiments. Obviously, school budgetary constraints are also a factor in determining how large or small a unit must be within a particular school's setting. On the other hand, "experiments" sometimes do not require terribly expensive items. Sometimes common hardware store materials can be used to simulate rather complex concepts. For example, something as simple as string, a few washers, a ruler and a piece of graph paper can involve students in actively constructing their own understanding of the physics of pendulums. The important thing is for planners to be realistic about what a project will require, while not succumbing to the trap of not doing something because the most expensive technology might not be available within the school.

Identifying and/or creating assessment tools (observation checklists, answer keys, rubrics, etc.) and appropriate evaluation criteria for use with each activity and the culminating performance.

Planners need to remember the distinction between testing and assessment. Although the culminating performance of the unit might be considered analogous to an end-of-unit test (albeit a performance-based test), each step (or activity) needs to be assessed along the way. If the performance is being used as the organizing principle of the unit, its steps might serve as appropriate points of assessment. For example, if the culminating demonstration were a class book, relatively formal assessment might occur at the research stage, at the topic narrowing stage, at the drafting and revision stage and finally at the final product stage. Along the way, teachers could implement behavior checklists to assess group interaction, self-monitoring, etc.

Planners should also incorporate assessment strategies that enlist and empower students in the evaluation process. At the least, students at all grade levels should be provided the criteria by which they will be evaluated throughout the project or unit. Better yet, students can be beneficially involved in the creation or articulation of those criteria. Just as teachers use a variety of tools and methods in reaching students of different skill levels and interests, they will need a variety of flexible tools to score (grade) increasingly open-ended and integrated assignments. Recognizing the variability of the ways students are likely to respond to situations, questions and prompts, teachers must design and implement an evaluation system that is efficient, reliable and reproducible.

As with other parts of the project's or unit's design, planners must first determine what is significant in the performance; that is, they must establish the criteria by which they will evaluate the students' demonstrations. After determining what is valued, it is a fairly simple matter to identify the most efficient tool for conducting the evaluation. The old saying that one

should use the simplest tool available is certainly true here. Some feel that every demonstration requires an elaborate rubric; others feel that everything can be handled by a checklist. Neither is true in every instance. If, for example, the primary or single interest (or point of evaluation) involves the student's ability to organize a body of information for presentation, then all one needs to evaluate in the demonstration is that one trait. If, on the another hand, the point of the evaluation is to determine the student's ability to communicate a personally meaningful message in whatever medium the student chooses with secondary interests in the student's ability to draw upon a variety of resource materials, then a more holistic approach is called for. The point is that the person or group doing the evaluating must first determine what is important in the students' demonstrations. Once the interest(s) are determined, the evaluator then turns to identifying or creating the most efficient, fair and reliable tool for measuring student success.

Process Models for Developing Integrated Units of Study

As one way to pull together the above activities, the following decision-making and problem-solving models (Foster and Walker, 1993) will not only help teachers sequence activities intended to lead students to successful completion of complex projects, but will also help them plan for formative and culminating products, select *Show-Me Standards* appropriate to the unit and identify natural moments for assessment and the kinds of assessment tools that will be required. Repeated practice with these models will also help students internalize practices that most would agree are part of thoughtful decision making and/or problem solving.

One warning, however, needs to made. Teachers must be careful not to so structure a unit that students do not need to (or are even prevented from) exercising their own logical powers or creativity. Consider the following example. Students are posed with the problem of determining how big a water tower a particular community needs. If the teacher provided data on the number of people living in the community, on the number of gallons a person might typically use in a day, and the number of days for which the tower needed to store water, students would need to do nothing other than discover (or remember) an equation and plug numbers into the equation. Is this problem solving? Probably not. If the teacher had students discover the data on their own, would the problem represent mathematical problem solving? Maybe, although it would be more of a research problem than a mathematical problem. Unfortunately, there is no simple formula for determining how much or how little scaffolding to provide students. Rather, teachers must exercise their knowledge of their students' abilities and how much ambiguity their students can tolerate to determine how much or how little to scaffold the project.

Two Models for Issues Analysis and Decision Making

Even though this kind of analysis is typically recursive, the following broad steps might be useful for leading students through issue identification and analysis and toward exploration of alternate points of view and subsequent actions. Readers familiar with the Show-Me Performance (process) Standards will see many direct connections in the following steps; possible connections are provided in parentheses.

1. **Information Gathering:** This first step would involve students in determining what is known about the issue (see Standards 1.1 and 1.2), in differentiating relevant from irrelevant information (1.5) and in determining what one needs to know (1.1); that is, in research and information accessing.

2. **Issue Identification:** This step would involve students in framing the issue, in determining a clear understanding of the issue, in identifying parameters of the issue and in determining who owns or is affected by the issue. (3.1)

3. **Idea Generation for Possible Points of View (inductive approach):** (3.5, 3.6)

4. **Evaluative Criteria Development (deductive approach):** Steps three and four involve developing criteria for identifying and evaluating divergent points of view and in establishing procedures for evaluating possible points of view against criteria, such as pro/con analysis, cost-benefit analysis, risk analysis, consequences analysis, implications analysis, or dialectic. (3.2, 3.3, 3.7, 3.8)

5. **Communication and/or Action Planning:** In this step, students communicate their opinions, recommend action to be taken or develop or communicate a plan for future action. (2.1, 2.3, 4.1)

An Alternate Approach to Issues Analysis

The following six-step procedure might be useful for framing the analysis of an issue, an historical event, or some societal action (for example, a court decision).

1. **Defining:** This first step would involve students in exploring such questions as how, where and why the issue originated, who was involved, what are the facts surrounding the issue and what is at stake. (1.2, 1.9, 3.1, 4.3)

2 /3. **Determining Concerns and Obtaining Predicted Consequences:** The next steps would call upon students to explore the concerns they or others have, are likely to have, or did have; the actual or potential consequences of the event, etc.; and how they or others would likely respond to the situation. (3.2, 3.3, 3.6, 3.8)

4. **Prioritizing:** This step involves students in ranking sub-issues and elements of the issue, in identifying levels of causality (that is, necessary, contributory, sufficient causes) and in distinguishing causality from coincidence. (1.6, 1.8)

5. **Assessing Sources of Information:** At this point, students need to examine the truth and validity of their sources—both their own knowledge and that which they have derived from outside sources. They need to question the depth of their information and to explore areas for which they need additional information. (1.7, 1.1, 1.2)

6. **Making a Decision:** With an in-depth understanding of the issues and consequences of actions, students would be prepared to make, articulate, evaluate and support a decision. (2.1, 2.3, 4.1)

Example: These six steps could be applied to explorations of an historical issue that has contemporary impact, for example, civil rights, or the creation of the water-use compacts among Missouri River states. A unit might lead students through an examination of primary and secondary historical artifacts to plumb their understanding of the issue or event. Depending on the event selected, students could be called upon to exercise mathematical content and processes in, for example, the context of an economic analysis (for example, use of the Missouri River for

transportation of goods), or science in the context of understanding mid-continent aquifers and their depletion. A task could then have the students apply what they had learned from history to a contemporary scenario, such as one state's desire to control the Missouri River for power generation and the effects of its action on other states who share access to the river.

A Problem Solving Model

Like decision making, problem solving is typically a recursive process. The following broad steps might be useful for leading students through problem identification and analysis and toward exploration of solutions and subsequent actions. Again, many connections to the Show-Me Performance Standards are evident in the steps.

1. **Information Gathering:** This step involves students in determining what is known about the situation, in differentiating relevant from irrelevant information, and in determining what one needs to know. (1.1, 1.2, 1.5)

2. **Problem Identification:** This step calls upon students to frame the problem, to determine a clear understanding of the problem, to identify parameters of the problem and to determine who owns the problem. (3.1)

Note: Steps 3 & 4 are two sides of the same coin.

3. **Idea Generation for Possible Resolutions (inductive approach):** (3.5, 3.6)

4. **Evaluative Criteria Development (deductive approach):** Here students would develop criteria for nominating and evaluating solutions and establish procedures for evaluating possible solutions against specific criteria, such as pro/con analysis, cost-benefit analysis, risk analysis, consequences analysis and implications analysis. (3.2, 3.3, 3.7, 3.8)

5. **Communication and/or Action Planning:** Finally, students would communicate their recommendation/solution or develop and/or communicate an action plan. (2.1, 2.3, 4.1)

Using the above outline of problem-solving steps, planners might consider a content-based approach to leading students through the process of building a knowledge base from which they can explore solutions. Students might be provided with a common resource packet (for example, readings, graphical presentations, situations, etc.) selected around a unifying theme; then planners could use the content within their curricula to structure the students' exploration of what they know and are able to do.

Important Reminders: Despite the temptation, planners should try to avoid subject-by-subject questioning (that is, posing several mathematics questions, then shifting to science, then shifting to social studies, etc.) Rather, activities and questions should be posed in as natural an order as possible even though that may require moving back and forth between and among content areas. Part of what students are expected to learn from integrated problem solving is the interrelatedness of knowledge. When planners cluster their own curricula, they remove the student's experience of figuring out how mathematics, for example, relates to science or social studies.

Planners should keep in mind that a single question might very well yield information about more than one process standard and even more than one content area. For example, a single activity might have students evaluate data presented in two tables and then present their evaluation in a short paragraph. The students' responses could then yield information for mathematics skills involving computation and data comparison, as well as writing and language use skills in communication arts.

Throughout the project or unit, students should be given opportunities to reflect on their responses and the choices they are making or are being asked to make.

Example problem

Students might explore the variety of accidents and emergencies that occur within the home. The final communication might be a home safety program (for example, a book, a presentation, etc.) divided into sections representing different locations within the home or different accident type categories (for example, kitchen accidents, fire safety, etc.). By the end of the unit, individual students might each create a chapter for a home-safety manual or prepare sections of an educational program for presentation to younger students.

1. **Gathering Information**

   Students could be involved in a broad range of research activities designed to help them explore the subject. Alternatively, students could be provided with a resource packet at the beginning of the unit that might include newspaper or magazine clippings of typical or frequent accidents within the home, graphical material or other representations portraying the problem (for example, who is involved, what kind of accidents are involved, how often people are involved, etc.).

   Using the above problem-solving model, students would proceed through a sequence of activities and questions that would help them discover what they know about home safety. An activity might include a class discussion of the kinds of accidents that occur in the home, intended to help students discover what they already know, where they might find information, what kind of information they would need to help them understand the scope of the problem, etc.

   Content-based activities and questions would engage the students in research, thereby helping them explore and refine their own knowledge. For example, the sub-tasks within "information gathering" suggest that students need to determine what is known and to differentiate relevant from irrelevant (or accurate from inaccurate) information. Selections from a resource packet would give the opportunity to assess reading skills, for example, involved with distinguishing facts from opinions and inferences, comparing, etc.; graphs and tables in the packet would give rise to such mathematics/statistics issues as data comparison and analysis. Additional reading and mathematics issues might involve the students in deriving and interpreting data from newspaper articles and assembling the data in tables and graphs, thereby affording opportunity to assess their computation, graphical presentation and interpretation skills. When coupled with self-analysis or reflection questions, content-based questions afford the opportunity to assess content-area-specific processes as well.

2-4. Identifying the Problem; Generating and Evaluating Possible Solutions

Following the problem-solving model, students would be lead toward articulating a statement (or definition) of the problem (Step 2), yielding, for example, a scoreable, paragraph-length response. Depending on the nature of the information revealed in their research or in their resource packet, students might conclude that the population most at risk is small children and that whatever solutions they later derive must address the particular needs of and dangers confronted by children. In other words, such a determination would require the students to analyze how best to present their home safety information to children, thereby involving them in the kinds of activities described in Steps 3 and 4 of the model (that is, possible solutions and evaluative criteria development).

In small groups, students might decide that they need additional information on the kinds of accidents most common among small children. One student in a small group might decide to interview a "911" dispatcher about the kinds of accidents reported to "911" and the problems children have in reporting accidents. Another student might decide to compare home first-aid kits to determine if one is commercially available that would meet the needs of children. Each student could then produce a short report (a form of which could be scored) in preparation for the next meeting of the small group.

5. Communicating Solution(s) and Action Plan(s)

After comparing their individual findings within the small group, individuals would then each create a chapter that would contribute to the whole manual or presentation. The student who interviewed the "911" dispatcher might prepare a chapter on what a child should do to report an accident. Since the group had already determined that its audience was children, the chapter would probably require pictures and text understandable to children.

Another strategy (and scoreable product) might involve designing an educational program for children that would teach them about home safety. Rather than a chapter, each student might create an outline or script and accompanying posters that could be used in a presentation for elementary school children; alternatively, a group of students might script, direct and perform a puppet show for young children on home safety. Planners should probably think of this closing (synthesizing, culminating) activity from the perspectives of all relevant content areas. Through successive scorings (that is, the teacher from each subject area would score the same response based on subject-specific criteria), the individual's response would yield information in each content area.

Problem-solving Steps 1 and 2 are particularly well suited to teaching and assessing content as the vehicle for building a knowledge base. Steps 3 and 4 ask the student to generalize and hypothesize alternate solutions and evaluative criteria from specific content. Planners might see these latter steps as "pre-writing" activities in which the students are asked to brainstorm and categorize solutions and criteria based on and drawn from the previous content-based activities. As a result of Steps 3 and 4, students might be expected to communicate a preliminary solution through a comparative analysis of the alternative solutions evaluated against their criteria.

Criteria for Evaluating Integrated Projects/Units

The preceding pages have identified a set of necessary activities in planning an integrated project or unit of study and discussed each in considerable detail. This final section turns those points of discussion into something of a rubric or scoring guide for assessing the effectiveness of the planning.

Above all, the project or unit must engage the student in actively constructing meaning about important subject matter. Learning can and should be fun, but fun without learning that is a direct outgrowth of the curriculum is merely a fun activity.

1. **The unit is based on a small number of *Show-Me Standards* and local curricular objectives, and is supported by several related *Standards*.**

Ultimately unit planners must articulate important knowledge and skills and connect individual activities to the knowledge and skills being taught and assessed. If a goal of the instruction is to determine what students know and are able to do and if a goal of assessment is to evaluate programs and curricula, then activities must be clearly connected to what they are intended to teach. Without an established connection prior to implementation of the unit, the unit runs the risk of becoming a 'dog 'n pony' show designed more to entertain the students than to teach them particular content and processes/procedures.

2. **The unit uses a scenario and context that is directly relevant to the students' knowledge and experience. It is authentic to the real world and to the students' experience.**

Although one can effectively design a unit based in the fantastic, it should still be presented within a plausible scenario and context. Moreover, the unit should be grounded in the students' experience, although extending the students' knowledge and experience base is a goal of all instruction.

3. **The activity is appropriate both to the age and development of the student and to what the student needs to learn.**

That is, if what the student needs to learn is a fairly closed-ended concept (like understanding the concept of volume), then the question posed to the student should reflect the nature of the concept. Consider again the following question, "Your town has outgrown its water tower's capacity. Using the data provided about your town's size and the average amount of water required for each citizen per day, determine how much water your town would need per month." This is indeed a fairly closed-ended situation. Only one path will really lead the student to the single "correct" answer. Certainly, one could score the students for their processes (methods), but there is really only one method and one correct answer.

Alteratively, if the task is more open-ended, then it should allow the student multiple entrance points (that is, students should be allowed to find their own paths to solving the problem) and possibly exit points. A truly open-ended task—something that is very difficult to construct—will allow for genuinely different solutions to the problem, several of which could be equally valid and correct.

4. **The unit should activate or access what students already know and should anticipate those points in a process or in a concept where students frequently get confused.**

In other words, the activity should recognize that students will bring knowledge to a problem; however, their knowledge may be incorrect. Therefore, by creating a situation in which students must challenge their prior knowledge, the activity should help them discover where their knowledge is incorrect and needs correcting. Think for example of a question about where plants get their food. In what activities could the students engage that would correct a common misconception that plants derive food from the soil? What do the students already know about plants that might lead them to conclude that plants derive food from the soil? What situation could create the cognitive dissonance necessary for them to seek a different answer to the question?

5. **The unit should be sufficiently scaffolded to assure that students are not unnecessarily frustrated, but open enough so as not to walk the student through a predetermined set of tasks that fail to acknowledge the student's creativity or challenge the student's understanding.**

Here is where cognitive taxonomies and logical process models will help planners structure (or scaffold) a unit without preventing students from testing their knowledge or applying their own creativity.

6. **The unit should offer students a variety of ways to reinforce, demonstrate and/or communicate their skills.**

This criterion acknowledges that students exhibit preferences in how they demonstrate and communicate what they know. Although writing is certainly an important communication skill, it is by no means the only way that adults are expected to communicate what they know or what they want done. Therefore, the emphasis here should be on a broader notion of communication, one that should include speaking, drawing, constructing, acting, and modeling in addition to writing.

7. **The unit should engage students in a full range of cognitive activity.**

Here again, frequent references to cognitive taxonomies will help planners think logically through what students would need to be successful at a project.

8. **The unit should require students to analyze and reflect on their solutions to a problem and to articulate their thought processes.**

If one of the goals of education is to learn what works as well as what doesn't work, students must be taught how to think their way through a problem. Similarly, if a goal of education is to empower students to become their own best evaluators, then, again, we must teach them how to self-assess. With these goals in mind, the unit should provide students with frequent opportunities to assess their own and others' work.

9. **If the project, unit or activity puts students into collaborative groups, planners might consider jig-sawing the activity such that each student within a group is responsible for a specific piece of the solution. A final step would then ask the group to assemble and assess their individual pieces.**

Students must learn not only how to function in groups, but also how to function independently (see Standards 4.5 and 4.6). Jig-sawing provides opportunity for students to learn how to identify the parts within the whole, how to assign themselves duties and responsibilities and how to assemble their individual parts into a new whole. From an assessment perspective, jig-sawing provides teachers a solution to the problem of how to evaluate individual performance within a group activity. If each student has been responsible for a piece of the solution or a piece of the research, then evaluation of the group can focus on such issues as group interaction skills as an issue separate from evaluation of the product itself.

10. **The unit should lead to one or more creative or communicative products. Alternatively, these products might be seen as stepping stones to a larger culminating product required by the unit. For example, if the unit required the students to create an environmental impact statement, the product for one activity within the unit might be a proposal to conduct research.**

This last criterion requires us to provide students an opportunity to put it all together, to extend their knowledge. In short, this is the teacher's opportunity to assess the students' higher-level thinking skills and the students' opportunity to demonstrate those skills. These culminating activities or questions must clearly establish the criteria by which the response will be evaluated. Ideally, the students will participate in the process of identifying those criteria. Establishing criteria at the outset provides the substance for the rubric(s) (or scoring guides) that will be used to evaluate the responses.

WHY INTEGRATE THE CURRICULUM?

The Learning Reason: What is Cognitive Science Telling Us About the Teaching and Learning Process?

Those involved in the Tech Prep movement will recognize the name of Dale Parnell. Although he is frequently associated with only vocational education, Parnell's comments go to the heart of why integration in any of its forms can be of enormous help to students. According to Parnell, cognitive research is discovering that intelligence and competence develop best out of interaction between obtaining knowledge and applying that knowledge (Hull & Parnell, 1991).

Within the arena of cognitive research, several approaches give educators powerful reasons to consider what they are teaching and in what kind of environments students are expected to learn. What follows are very brief discussions of several lines of reasoning that teachers might want to explore; suggestions about where one might go for additional information appear in "References."

The Multiple Intelligences Approach

Howard Gardner's work is one such approach. Gardner's research asserts that each of us possesses several distinctive kinds of intelligence and that each kind of intelligence is equally valuable to us in a complex world. Gardner (1983) has identified seven different intelligences: linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, interpersonal and intrapersonal.

School frequently focuses on only a small portion of human intelligence. Academic programs tend to focus on linguistic and logical-mathematical intelligences; vocational-technical programs tend to be just as narrowly focused on the spatial and the tactile component of the bodily-kinesthetic intelligence. According to Gardner and others, a rich curriculum based in an awareness of the variety of ways students come to understand their world will help them recognize their strengths and strengthen their weaknesses. This approach suggests that all learning experiences should engage students in interacting with information, ideas and concepts in a variety of ways and from a variety of perspectives. Although Gardner's work does not specifically suggest combining subject areas, it does argue for contextualizing learning and engaging students in a variety of kinds of learning. As curriculum integration was defined in the previous section, this kind of integration should, at the least, occur within a subject area.

The Brain-Based Research Approach

According to this research, the human brain seeks connections; therefore, curriculum, instruction and assessment practices that emphasize learning from parts to whole tend to interfere with the brain's innate capacity to and propensity for establishing connections, for generalizing— sometimes correctly and sometimes incorrectly. Integration within and across subject areas is a logical response to fragmentation of concepts and separation of one subject area from another. If fragmentation is a real impediment to learning (that is, the ability to transfer learning from one situation to another), then curriculum integration offers an opportu-

nity for students to be taught **how** to transfer rather than merely hoping that they will pick it up along the way.

The following observations from Caine and Caine (1994) about the working of the human brain reinforce the assertion that integrating the curriculum promotes effective learning:

- "The brain has an enormous innate capacity to deal with parts and wholes simultaneously. The brain can deal with the interconnected, interpenetrating, 'holographic' world, **provided it is encouraged to do so**. One common element of effective methods is a sense of 'embeddedness'—a sense of wholeness that emerges out of seeing how subjects relate to each other and how people relate to them. **(Integration of the curriculum is one approach to learning that is so powerful because it orchestrates complex experience in a way that takes advantage of what the brain does well. It does not limit the brain by teaching the memorization of isolated facts and details.")** (emphasis added) (p. 39)

- "Brain research establishes and confirms that multiple **complex and concrete** experiences are essential for meaningful learning and teaching. Optimizing the use of the human brain means using the brain's infinite capacity to make connections and understanding what conditions maximize this process." (emphasis added) (p. 5)

- "The brain appears to have an innate ability to look for patterns." (p. 89)

Another line of reasoning supporting the important role curriculum integration can play in learning portrays the brain as an interconnected system in which information acquired in one situation is stored in only one place in the system while information that is acquired (and used) in several situations is stored in several places in the system. The old euphemism of "cramming for the test" takes on new meaning in this context. That is, when one crams for the test, one is cramming that information into one place within the system and the information remains disconnected from other places in the system, hence it is less likely to become a permanent part of one's memory. On the other hand, information that is learned in one context, applied in another, thought about and reflected upon in yet another ends up being stored in several places of memory, hence increasing the likelihood of it becoming part of one's long-term memory. Here again, integrating the curriculum offers an opportunity for students to learn to transfer their learning and maybe suggests an answer to the age-old question of why students can't remember something when teachers know that they taught it.

The Constructivist Approach

The constructivist view of learning emphasizes the learner's active participation in making sense of the world and of the opportunities created by active, integrated learning. According to Duckworth (1987), education must put students into direct contact with the phenomena or concepts to be learned—the real thing—not just books and lectures about them. Further, educators must challenge students to try to explain the sense they are making, listen to them, and try to understand their students' sense instead of explaining things to them. As students try to explain, they also begin to question and seek out more information to shed light on the subject in the process of constructing their own knowledge of the subject. These assertions call for applied learning, discovery learning, introspection, reflective learning and similar student-centered approaches. This view of learning also acknowledges the importance of relevance for the student, as attested by Grubb, et al. (1991): ". . . for most people effective learning requires a context that matters to them." (p. 83)

Such a view of teaching and learning acknowledges that the student brings to the learning situation a wealth of experiences that must be constantly tested against new information, ideas, concepts and phenomena. "Each of us makes sense of our world by synthesizing new experiences into what we have previously come to understand. Often, we encounter an object, an idea, a relationship, or a phenomenon that doesn't quite make sense to us. When confronted with such initially discrepant data or perceptions, we either interpret what we see to conform to our present set of rules for explaining and ordering the world, or we generate a new set of rules that better accounts for what we perceive to be occurring. Either way, our perceptions and rules are constantly engaged in a grand dance that shapes our understandings." (Brooks, 1993, p. 4) In addition to constructivism's emphasis on acknowledging and accessing what students already know, constructivism asserts that much learning occurs within a social rather than a solitary context. When seen from this perspective, teaching shifts from transmitting information from the teacher's mind to the student's to teaching as creating an environment in which students are constantly challenged to formulate questions and seek answers to those complex questions.

Brooks and Brooks (1993) provide the following five overarching principles of constructivist pedagogy: posing problems of emerging relevance to learners; structuring learning around "big ideas" or primary concepts; seeking and valuing students' point of view; adapting curriculum to address students' suppositions; assessing student learning in the context of teaching. As with Gardner's arguments, Brooks' and Brooks' arguments are not a direct appeal for crossing subject area boundaries. However, as it is usually practiced, integrated learning changes the relationships between the student and the teacher, among students and between the students and the subject matter being studied. Rather than focusing on discrete skills, integrated learning typically focuses on problems students are likely to encounter in the real world. Its real-world and student-centered focus makes reliance on textbooks very difficult (admittedly a mixed blessing). Its frequent emphasis on group problem solving similarly discourages learning in isolation and encourages each student to bring to the problem his/her best talents. Finally, thinking is valued in that problems derived from the real world rarely lend themselves to single right answers; rather they call on students to seek multiple perspectives and multiple routes to success.

Integrating Curriculum, Instruction and Assessment Practices

The following "maxims for learning and instruction" (Anderson & Armbruster, 1990) pull together the different approaches described above and offer in the process something of a blue-print for teachers who are thinking about how and what they teach. The maxims were derived in part from the authors' own experiences and from cognitive science, particularly the work of Spiro (1988), Brown, Collins and Duguid (1989) and Vygotsky (1978).

Maxims for Learning and Instruction

1. **Whole to Part**
2. **Authenticity**
3. **Multiple Perspectives**
4. **Developmental Progression**
5. **Action Orientation**
6. **Modeling**
7. **Coaching**
8. **Scaffolding**
9. **Reflection and Articulation**

1. **Whole to Part:** Learners need a map of how the parts fit together. Curriculum should be organized around big ideas; instruction, using complete cases and tasks, should move from whole to part, thereby facilitating the learning of subskills and subconcepts within the context of the whole (p. 398).

2. **Authenticity:** Learning experiences should model as closely as possible the complexity and richness of reality. Such experiences make learning more meaningful, facilitate transfer of learning and develop more functional and flexible knowledge (p. 398).

3. **Multiple Perspectives:** Viewing authentic cases and situations from multiple perspectives helps learners develop skills needed to cope effectively with the complexity and novelty of real-world situations (p. 398).

4. **Developmental Progression:** Learners develop from novices to experts, demonstrating along the way growth and progression in the quantity and quality of what they know, what they are able to do with their knowledge, and when to use what knowledge (p. 399).

5. **Action Orientation:** Rather than being passive recipients of information, learners should be active participants in their learning; learning and action must be closely related to develop students' understanding of content (p. 400).

6. **Modeling:** Teachers should model their thinking for learners; modeling of this sort helps students develop thinking skills and attitudes (p. 401).

7. **Coaching:** Teachers observe and help learners as they perform tasks—directing, reminding, hinting, providing feedback and designing and sequencing new tasks that bring student performance closer to expert performance. Coaching is more collaborative than evaluative in that its purpose is to support and develop student confidence (p. 401).

8. **Scaffolding:** Teachers provide the appropriate amount of support and challenge to permit learner success. Effective scaffolding requires selection of tasks of appropriate difficulty, knowledge of learner skills and development and presentation of sufficient challenge to promote rather than stifle progression toward expert performance. Scaffolding fades as the student internalizes a model of expertise (p. 403-404).

9. **Reflection and Articulation:** Reflection is thinking about one's own knowledge and comparing it with those of an expert or another learner. The goal is to help students monitor their own knowledge and thinking and to bring it into line with expert performance. Articulation refers to verbalizing reflective thinking for purposes of sharing and/or refining one's knowledge and skills (pp. 403-404).

The Work Force Reason: What is Business Telling Us About What Students Will Need in Their Future?

For most of this century, the United States exported its goods and expertise to the world. Domestic technology centered around mass production emphasizing basic worker abilities, such as punctuality, consistency and reliability. A strong back, a willingness to work and an eighth-grade certificate were all that one needed to make a start in the workplace. Today,

demands on workers and businesses have changed radically. A well-developed mind, a willingness to learn and the ability to put knowledge to work are the new keys to the future of the high school graduate, the success of our businesses and the economic well-being of our nation. (SCANS, 1991)

In the last three decades, globalization of commerce and the explosive growth of technology on the job have changed the terms of needed skills for the high-school graduate and by extension for students at every grade leading up to graduation. (SCANS, 1991) Coupled with the explosive growth of technology is the equally explosive growth of information. This combination of changes in the marketplace and the information explosion of which we hear and experience so much have enormous implications for schools and students who hope to succeed in the next century. As described in the report "Collaborative Strategic Planning Model for Improving School-to-Work Transition," "restructured schools should take on the characteristics of high-performance work organizations in which team work, problem solving and knowledge construction are routinely practiced." (Center for Education and Work, 1993, p. 2) The landmark 1991 SCANS report identified five competencies the workplace will require of its employees in the future.

The Five SCANS Workplace Competencies:

- **Resources:** ability to allocate time, money, materials, space and staff
- **Interpersonal Skills:** ability to work on teams, teach others, serve customers, lead, negotiate, and work well with people from culturally diverse backgrounds
- **Information:** ability to acquire and evaluate data, organize and maintain files, interpret and communicate, and use computers to process information
- **Systems:** understanding of social, organizational, and technological systems; ability to monitor and correct performance, and to design or improve systems
- **Technology:** ability to select equipment and tools, apply technology to specific tasks, and maintain and troubleshoot equipment.

In order to get to this point, SCANS designated the following "three-part foundation" that all employees would need: basic skills (reading, writing, arithmetic, math, speaking and listening); thinking skills (ability to learn, reason, think, make decisions and solve problems); and personal qualities (individual responsibility, self-esteem, self-management, sociability and integrity). (SCANS 1991)

The authors of the SCANS Report sum up their review of what students entering the marketplace will need as follows:

> The message to us was universal: good jobs will increasingly depend on people who can put knowledge to work. What we found was disturbing: more than half of our young people leave school without the knowledge or foundation required to find and hold a good job. These young people will pay a very high price. They face the bleak prospects of dead-end work interrupted only by periods of unemployment. (SCANS, 1991, p. 1)

These competencies and skills are not intended for the special tracks labeled 'general' or 'career' or 'vocational' education. All teachers, in all disciplines, should incorporate them into their curriculum and instruction practices. It is no coincidence that the *Show-Me Standards* and

these *Frameworks* have emphasized quite similar issues for Missouri's students. As a reminder, the *Standards* are of two types: performance (process) standards that are intended to apply across all subject areas and all grade levels and knowledge (content) standards that intended to apply across all grade levels within a subject area. Thus the *Standards*, particularly the performance standards, present a direct appeal for integrating student learning and teaching students how to transfer what they may be learning in one subject to other subjects and contexts—both within and outside of the school setting.

To locate these needs more directly in the context of what schools have and have not traditionally focused on, consider the following observations (Resnick, cited in Adelman, 1989):

1. In school, learning and assessment of what has been learned are almost exclusively individual activities. Outside of school, most activity is socially shared and "success" is the result of group effort.

2. In school, the bottom line is what students are able to do unaided by external supports of "tools" (such as, books, notes, calculators, etc.). In contrast, the use of tools is encouraged or even required in the world of work to increase efficiency and accuracy.

3. School learning is largely symbol-based and far removed from any connection to real objects or real problems. Concrete problems must be solved many times using paper exercises. Research indicates that in the real world, people routinely solve concrete problems easily and accurately that would stump them as paper exercises.

4. The school's mandate is to teach broadly applicable skills and theoretical principles that are presumed to be transferable. However, evidence is accumulating that the skills learned in school have limited transferability to specific situations outside of school.

As it has been defined, integration on even the most simple level must incorporate the real-world into learning, thereby helping students not only learn to apply their knowledge but also helping them experience how adults use knowledge.

The School Efficiency Reason: Who's Responsible for Teaching Students What They Will Need to be Successful?

It takes a whole faculty (working together) to educate a student. That is, no single teacher should or can be held responsible for teaching students all of the knowledge traditionally associated with a particular subject area. Mathematics teachers cannot be solely responsible for students' mathematical skills; English teachers cannot be solely responsible for students' communication skills; social studies teachers cannot be solely responsible for preparing students to be responsible citizens; vocational-technical teachers cannot be solely responsible for teaching students how to earn a living; and the list goes on and on. By definition, integration can balance the responsibility for instruction across a faculty, thereby shifting faculty responsibilities from isolated instruction to collegial planning, coordinating and facilitating.

Moreover, consider how much duplication exists across a curriculum in the absence of communication across a faculty. Students are taught to gather data in their mathematics class, in their English class, in their social studies class, in their science class; yet teachers in each will

observe that they must reteach data gathering each hour of the day. What might explain the students' apparent inability to gather data? When students do not see the connection between what they are learning in English class and what they are learning in science class, they need to be retaught the knowledge and skills in both classes. Another version of this teacher comment sometimes centers around how students are not putting in the time for their class; yet parents will conversely observe that their children come home each night with an hour or more of homework from each of their six or seven classes. Integration (or at the very least communication) offers the beginning of a solution to the teachers' and the students' dilemma. Consider the following anecdote from a Missouri teacher who has been involved in integrated studies for several years:

> There were a lot of times when they [students] were writing two or three papers at once. They were writing an English paper, a social studies paper, a research paper for science. I always thought to myself, "why can't we make this one paper, one research paper?" I see this as letting the kids have a better understanding of one topic rather than trying to do three things at once.

Curriculum integration of even the simplest form requires teachers to be aware of and acknowledge what their colleagues are doing. Yet another potential time-generator involves regaining the lost time at the beginning of a year; that is, teachers are very aware of how much students lose across the summer break. If, on the other hand, knowledge and skills can be more firmly planted in long-term memory when the knowledge and skills were first studied, applied and reinforced throughout the curriculum, then there's the potential for not spending so much time recovering what is typically lost during the summer.

When seen from this perspective, integration creates two very important opportunities that are sometimes not possible in a traditional subject-specific or departmental structure:

- First, integration requires communication among a faculty. By communicating with each other, teachers naturally recognize intersection points where they can reinforce what their colleagues are teaching.
- Second, integration requires students to transfer what they are learning from one context to another. In the teaching-learning process, most would agree that students must shoulder their fair share of responsibility for their own learning; however, they must not only be encouraged to do so but also taught how to do so. Curriculum integration provides an opportunity to show students how skills relate to each other and to their lives.

Benefits of An Integrated Curriculum

More and more educators across the nation are using an integrated approach to student learning. What motivates them to integrate the curriculum? While there is no single answer to this question, integration clearly has many benefits, not only for administrators and school boards, but for students and teachers as well.

Benefits for Students

What's in it for the students? As expressed by a library/media specialist in a Kansas City high school, "simply put, it motivates students and establishes goals for the future." When educators report the results of integration projects all across the country, one common theme is

often present–students become more engaged in their studies. In addition, they have noted the following kinds of benefits for students:

- Students in integrated classrooms are allowed—and often expected—to work at their own pace. Ideally, more advanced students in an integrated classroom are not required to wait as other students get "caught up" as would be the case in a tradition whole-class instruction model. This gives self-directed learners more freedom to demonstrate their abilities and more individual attention to students who learn best through small-group instruction.

- Since integration often involves more than one teacher and more than one subject area, students have access to more than one expert and more than one perspective on the topic of study. Although not all integrated curriculum involves team teaching, this flexibility gives students exposure to a wider range of teaching styles and perspectives than they might otherwise experience.

- Integrated teaching typically embeds instruction within a real-world context. Through focusing on issues or problems occurring in the real world, students are challenged to think like adults and to apply skills from across the curriculum. As an inner-city student expressed it, "Of course I learn more. It [his integrated study] taught me about the working world. They're giving us a basic education and how it relates to the world."

- Schools and teachers using an integrated approach have also reported improvements in their students' pencil-and-paper achievement test scores (Kolde, 1991). Ohio schools involved in a state-funded program reported that experimental groups of students receiving integrated instruction scored higher on achievement tests than those taught traditionally. A junior high science-technology team offers the following comment on their students' retention of information: "After doing an integrated unit on gas laws, the kids could tell you basically what the universal gas law was months after we did it in class, because we took apart the refrigerator and saw why it got cold here, warm there. In several cases, a student would say, 'I never knew how this stuff worked; I never really cared.'"

- Teachers observe that attendance goes up when students are engaged in contextualized integrated study. One Kansas City teacher asserts that prior to her school's emphasis on integrated study, absenteeism was as high as fifty to seventy percent. Now that the school is organized around career paths [see discussion of Career Paths in an earlier section] and emphasizing integrated projects, "attendance is way up."

Because students learn in different ways and because it is difficult—if not impossible—to reach all students simultaneously using the same teaching style, an integrated approach to education, by providing a context for the material to be learned, allows students more of an opportunity to approach their education from their own learning style. Meanwhile, as achievement test scores have shown, teachers have been successful in maintaining academic standards in an integrated environment. Indeed, many programs focusing on math-science integration end up helping students develop a considerably higher degree of understanding about the two subjects. As observed by a high school principal, "We all knew all along that there were students who, when the bell rang, put science away and went to math. We were asking them to bridge the gaps on their own." Now that the math and science curricula have been integrated, students experience first hand how indispensable are their math skills when they are trying to conduct scientific inquiry.

Benefits for Teachers

When asked what he saw as a benefit of integration, a high school math-science teacher responded, "From a teaching standpoint, the biggest benefit for me is that I have had to force myself to communicate with other professionals. This kind of communication has made me a more well-rounded teacher." The importance of professional communication cannot be overestimated. Traditional single-subject teaching isolates teachers just as it does students. Many teachers observe that before their integrated planning initiatives, they rarely had opportunity to converse with their colleagues.

Other teachers have observed that through integrated study, students tend to learn the material more deeply and remember it longer. According to an elementary library/media specialist, "We used to teach research skills and the card catalog separate from actually doing a research project. When the students were actually called on to do research, they didn't put the experience of learning how to do library research with the experience of learning. Now we do them together. The kids love to learn this way. They get much more positive, much more enthusiastic. They don't even realize they are learning."

Another benefit derives from a recognition that there isn't enough time in the day for every teacher to separately plan integrated activities. The high-school teacher quoted above also observed, "If each teacher tried to have an authentic task for just his/her subject area, there would be very little time left for actual teaching. So when you group three or four subject areas together under one authentic task, assessment becomes both realistic and efficient."

Certainly, these benefits should be good news for teachers. Many teachers, however, worry that they will have to slow down, that they won't cover as much, or that integration will be on top of the regular mandated curriculum. According to the chair of a Missouri high school science department, "As far as content is concerned, I haven't backed off any of the content, the number of units, any of the vocabulary. I have taken less time in lecturing, but I put more responsibility on their [the students'] shoulders. I've been doing this [integrated] class for eight years, and I'm right where I always was with this course." According to another teacher who practices integrated study, "Every unit we do covers some MMAT objectives. Since the students are expected to 'be able to calculate density and volume' and to 'be able to understand Archimedes' principle,' we designed a project where the kids learn these objectives. Density, for example, is automatically worked into the submarine project. They [the students] can't do the project successfully without really understanding scientific principles." Obviously the key to covering the curriculum is to plan integrated activities around the regular curriculum.

Benefits for Schools and Administrations

Several benefits of integrated education which have been presented here—including lower drop-out rates, higher achievement test scores, fewer unnecessary school nurse visits, higher motivation reflected in lower absenteeism, increased homework completion and the like—are qualities of integrated instruction which directly benefit schools and administrators. To be sure, the benefits of integration for students and teachers are benefits for the whole school.

But in addition to improving the operation of the school, there are pedagogical reasons for administrators to consider integrated education. Research in cognitive theory asserts that intelligence and competence are best developed in students through the acquisition and appli-

cation of knowledge. (Hull 1991; Anderson 1990) Similarly, a recent review of brain research (Caine 1991) suggested that integration and student learning are strongly linked. Simply put, students appear to learn better when the school curriculum is integrated. Some subjects in the curriculum have a long history of internal integration. Foreign-language instruction, for example, has for some time been integrated with cultural content. In many elementary classrooms, reading is integrated with what the children are studying in social studies or science. Examples such as these can be used as the foundation for more widespread integration.

Benefits for Business

Students who learn in an integrated environment are afforded skills which employers expect of potential employees. Employers of all kinds are realizing that competing in worldwide marketplaces requires employees who will not be hindered by a narrow view of the world and employees who can put knowledge to work. Integration goes a long way toward addressing these goals by presenting students with meaningful contexts for learning and multiple perspectives from which to examine problems. When students are presented realistic problems—problems for which there is typically not a single correct answer—they must use knowledge and skills from various subject areas to succeed in their education. One solution to the problem of implementing useful change in education is to cease thinking of technical and liberal education as opposites. A study, for example, funded by the Illinois State Board of Education stated that if academic and vocational education were integrated, an improved workforce could result with less time and money being expended for costly remedial training.

HOW DO WE ASSESS STUDENT PERFORMANCE IN THE CLASSROOM?

Challenges and Trends for Classroom Assessment

The emphasis on integrated learning, higher-order thinking skills, student performance, problem solving and learning-to-learn present some unique challenges for assessment. Assessment as end-of-unit testing of facts is, at the least, incompatible with these current emphases in classrooms. Fortunately, new tools and perspectives are being developed and/or rediscovered that are designed to expand on traditional notions of what it means to assess students. These major trends and significant challenges include

- shifting the emphasis from end-of-instruction summative assessment to in-process formative assessment procedures;
- blurring the sharp distinctions that have existed between instruction and assessment;
- developing assessment procedures and tools that capture students' abilities to think critically, to solve problems, to connect their learning with other learning and to extend their learning to real-world applications;
- structuring assessment such that students become more invested in the process of assessing their own learning;
- developing reporting mechanisms that are capable of capturing and communicating the richness of student performance and achievement;
- developing assessment techniques that focus on the critically important area of collaborative skill development; and
- developing assessment procedures that reach beyond what students know to what they are able to do with their knowledge.

Such is the challenge facing all educators—regardless of the level of their teaching and regardless of the degree of curriculum integration they are attempting in their classrooms. The following pages will give teachers and administrators a brief introduction into a variety of issues, challenges and tools available to meet these challenges.

A Performance-Based Approach to Assessment

One of the most exciting and promising approaches to assessment to grow out of the *Show-Me Standards* is performance-based assessment (sometimes referred to in a more narrow sense as authentic assessment.) Performance-based assessment refers to a wide variety of measurement techniques designed to correspond as closely as possible to the real world of student's experiences.

In many respects, this approach to assessment requires that everyone involved in education (including students, teachers, administrators, parents, etc.) rethink some traditional notions about what assessment is and how it should occur. For many, if not most, the term *assessment* is really a code word for *test*. Most students see testing as an event that is quite distinct from the rest of their learning experience. It is something that happens on a special day, at an appointed hour. Lessons, labs, teaching and all the rest come to a halt. Students are separated from one another. Everything gets quiet, and the atmosphere is typically full of anxiety.

A performance-based approach to assessment represents something distinctly different from traditional testing. Rather than being a kind of contrived event occurring at a certain point in time, assessment becomes an ongoing and integral part of the whole teaching and learning process. The single testing event model shifts to assessment as interwoven throughout the entire educational process. In a nutshell, the performance-based and process approaches to assessment blur the lines between learning, testing and assessment. These components merge together as a coherent whole rather than being artificially compartmentalized.

Characteristics of Performance-Based Assessments

A wide range of tools and procedures have been developed for performance-based assessment. Portfolios, demonstrations, exhibitions, recitals, etc., all share some things in common that are worth considering as teachers strive to make the most of their assessment of students. These assessments should be connected with and embedded within an activity or experience that is itself meaningfully connected to the students' experiences. They should probe the students' abilities to integrate and connect their learning, not only across the various subject areas but extending to real-world applications, career interests and future learning. They should engage students in doing, performing, making, debating, etc. They should explore students' higher-order thinking skills, such as problem solving, decision making and critical thinking. They should confront students with situations that are not reducible to a single, correct answer, thereby calling upon students and teachers to exercise their human judgment. Finally, they should involve students in processes of identifying, clarifying and selecting educational goals, as well as in helping them learn how to assess themselves in light of meaningful goals.

Key Design Features of Performance-Based Assessments

Assessment need not be isolated from learning. Instead it should be a natural part of the learning process. It should be an open, engaging and interactive process that occurs with students rather than to students. With that goal in mind, assessments are designed to

- mirror or simulate real life activity, where students are engaged in real life problems;
- continuously involve students in the assessment process through peer and self assessment;
- examine the processes as well as the products of learning; this includes learning how to clarify problems, knowing how and where to go for information, being able to transfer and apply their leaning to similar (but different) situations;

- provide multiple sources of information to provide feedback on student growth in numerous situations over time;

- blur the lines between learning, teaching and assessment with an emphasis on continuous, formative and process-based assessment where learning and assessment happen simultaneously with lots of interaction between teachers and students; and

- connect with specific criteria where a variety of assessment tools are used to determine the extent to which students have met the goals and objectives targeted for a given learning experience. (adapted from Herman, Aschbacher and Winters, 1992; Wiggins, 1993)

Criteria for Assessing Performance-Based Assessments

Performance-based assessment procedures should be subjected to critical examination. In other words, the assessment procedures should themselves be assessed. Some ideas might look good in theory but fail due to a number of implementation problems. Experts in assessment (Darling-Hammond, 1990; Medina and Neill, 1988; Newmann, 1991; Resnick, 1987; and Wiggins, 1991) generally agree on a set of three big concerns that should be used to evaluate the value of assessment tools and practices.

Excellence

Does the assessment contribute to educational excellence? Teachers should evaluate the degree to which students are required to construct their own meaning for knowledge rather than recognizing someone else's ideas. In this way students are forced to be constructive rather than reactive. Teachers need to insure that the assessment does in fact elicit higher-order thinking from the students. The assessments should retain the complexity and multiple responses natural to real-world problems. They should produce a direct assessment of the students' abilities rather than rely on indirect indications of performance. For example, for many years teachers relied on sentence-editing exercises to determine students' writing skills; today, most teachers would agree that if they want to learn whether their students can write, the students must write. And finally, teachers should evaluate the degree to which the assessment is integrated within instruction rather than being separate from instruction.

Equity

Does the assessment insure equity? Performance-based classroom assessments are intended to sample student performance over a more extended range of time than do traditional tests. Rather than restrict assessment to a limited framework of time at the end of a unit of instruction, these measures are designed to serve a formative process by examining performances repeatedly over time. Increasing equity also challenges teachers to establish clear expectations of what they need to see in the students' performance. If done in an open manner and in full view of the students, the criteria for evaluation shift the focus away from comparing one student to another and toward comparing each student to the stated criteria. Finally, these measures (particularly those occurring within an integrated curriculum) involve multiple evaluators. In this way performance-based assessment tends to open the process of assessment and the conversation surrounding the assessment. At a minimum, assessment is opened to include peer and self-assessment. In this way, students are exposed to multiple perspectives on the quality of their performance and less inclined to believe that some single person is solely responsible for evaluating their work.

Efficiency

Is the assessment efficient? One criticism of performance-based assessment is that it is time consuming and inefficient. If done properly, assessment practices can help steer educational systems toward deeper and more meaningful forms of efficiency. In this regard, assessment practices can serve to force the issue of curriculum and instructional alignment, to enhance teacher performance and focus energy on the kinds of student learning and performance that really count, and to develop in students their abilities to monitor and assess their own learning.

Standards for Quality Assessment Procedures

Just as the assessment activity should be evaluated, so too should the procedures under which the assessment is developed and administered. In much the same manner that there is a nationwide thrust toward developing standards for student performance, there is also a move to establish standards for assessment. The Center for Research on Evaluation, Standards and Student Testing (CRESST) has developed a useful set of standards that should be considered whenever evaluations are being constructed and conducted.

Consequences

This concern involves thinking through, in advance, the potential consequences of an assessment procedures. Some excellent ideas look good in theory, but turn out to be bad practice. Teachers should ask themselves whether the assessment does in truth retain complexity of what they are trying to measure, whether the assessment will enhance or disrupt the learning process, and how they will use the results of the assessment.

Fairness

A key instructional and assessment issue has to do with fairness. Teachers must assure themselves that the assessment will be fair to all students. They can effectively begin by questioning whether the assessment favors one kind of learner over another; for example, does the assessment task give proficient readers an undo advantage over less proficient readers, particularly if the primary point of the assessment is not reading skill. Similarly, teachers should consider whether their assessment practices are sensitive to the cultures represented across their students.

Transfer and generalizability

This concern relates directly to the need for assessments to measure what they are intended to measure and to measure consistently in the same way. Teachers need to ask themselves whether the results of the assessment are really indicative of what students need to know and be able to do. They also need to ask themselves whether someone else would see the students' performance in the same way they do. This concern is a direct appeal for teachers to be very clear about what they are expecting of students. By carefully clarifying and communicating expectations, teachers can increase the likelihood that everyone (students, parents, other teachers, etc.) will interpret the student's performance in similar ways.

Cognitive complexity

One of the key features of performance-based assessment (particularly when it is used to assess integrated and connected learning) is that it be sensitive to the cognitive complexity of

students. Teachers need to ask themselves whether the assessment actually captures the ways students think or whether it really only measures students' possession of facts or basic skills. If the assessment focuses on problem solving, does it in fact assess their problem-solving abilities as well as the processes by which they solve problems? As discussed in earlier sections, this concern is a challenge for teachers to pose students with problems for which there is not a single path to the solution.

Content quality and content coverage

Content quality focuses teachers' attention on assessing those big ideas, themes and major concepts that organize their subject area. Content coverage refers to the degree to which an assessment can (or should) measure the entire range of content within a concept or theme. Typically, teachers will attempt to sample the full range within each performance-based assessment. This sampling forces teachers not only to be aware of the entire range, but also to be aware of what parts of that range they have previously sampled or have yet to sample. In this way, teachers and students will be able to tell whether they are emphasizing one area over other important areas.

Meaningfulness

This criteria is at the heart of authentic assessment. Certainly one of important trends in education over the past decade or so has been to engage students in meaningful, real-world tasks. Teachers should, therefore, ask themselves whether their assessment tasks are actually authentic to the world or are they remote to the way adults actually perform and therefore remote to the ways students will one day be required to use their knowledge.

Cost and efficiency

As with any endeavor, there is always the problem of transferring good theory into sound practice. Performance-based assessment is capable of accurately reflecting the higher-order thinking skills of students as well as their ability to connect, to apply and to transfer knowledge to new situations. It is not well suited, however, to assessing students' possession of a specific set of facts or skills. Therefore, teachers need to prepared with an array of assessment tools, each suited to capturing the particular kind of information for which it is best suited. Performance measures obviously best capture performance; more traditional measures, such as multiple choice, fill-in-the-blank, etc., are similarly best suited to capturing knowledge. Teachers and their students will be best served when assessment procedures include an array of methods to determine what students know and are able to do.

Assessment Tools Available to Teachers

In addition to the traditional assessment tools used by teachers for generations (multiple choice, short answer, even essays), today there is much discussion of what are sometimes called alternative assessment tools. Broadly, these alternatives can be categorized as performance tasks (or events); projects, exhibitions, and demonstrations; and portfolios. Below are very brief discussions of each. It is important for teachers to keep a couple of things in mind. First, although these assessment tools may be receiving new-found attention, none is particularly new to education; indeed, good teachers have been using a combination of them for generations. Second, none of these tools (neither traditional nor alternative) is sufficient by itself. Good assessment practices require teachers to carefully align what they need to learn about their

students' knowledge and abilities with the assessment tool most suited to revealing that information. In other words, there is no single, perfect assessment tool; each is particularly well suited to determining particular information.

Performance Tasks (or Events)

Performance (events) are probably the kind of performance-based assessment attracting the most attention. Indeed much of what this section of the Frameworks has described leads teachers to posing their students with rich, reality-based tasks. Quite simply, tasks (or events) call upon students' to demonstrate their abilities to apply knowledge and skills in the service of producing some product within a reality-based context. This definition also reveals what tasks are best suited to reveal; that is, tasks show us our students' ability to apply their knowledge and skills. Good tasks exhibit several characteristics. They are engaging; that is, they frequently are set within current topics, and they engage students in thoughtful activity. They model good instruction; that is, they make students active participants in their learning. They are rigorous, thereby challenging students to exhibit their best work. They address real problems, important issues, and important elements of the curriculum. They tap into a range of thinking strategies and allow students to communicate in several ways. Finally, they are scorable; that is, they clearly identify the criteria (and frequently the procedures) by which students' work will be evaluated.

Projects, Exhibitions, and Demonstrations

For many teachers, projects, exhibitions, and demonstrations are really only distinguished from performance tasks in the sense that they usually take longer to prepare for and complete than does a task and they probably contain several tasks. Some teachers will make the additional distinction that projects are frequently more student-directed than tasks. That is, where the teacher might assign the task, the student identifies the project that most interests him or her. In this sense, projects offer the additional benefit over tasks of revealing students' abilities to select an area of interest and pursue it to completion.

Both tasks and projects frequently pose students with a contextualized prompt. Prompts can be distinguished from questions in that a prompt provides students with a springboard from which to launch their investigations. In that prompts should not presume a specific answer, they are particularly suited to revealing students' abilities in synthesizing information, in applying knowledge and skills to new situations, and in critical thinking. Questions, on the other hand, are narrower in their purpose. Questions are best suited to eliciting specific answers. In this sense, questions are particularly suited to revealing student knowledge and performance on recall, analytic processes such as process analysis, and even some of the more routine kinds of problem solving. Tasks and projects will frequently employ both prompts and questions.

Portfolios

Where tasks and projects capture student performance at a point in time, portfolios are particularly well suited to revealing student growth over time. In addition to their ability to show growth, portfolios offer potential to increase students' sense of ownership in their work. They provide opportunity for students to exhibit not only what they have learned, but also how

they learn, how they construct, extend, and refine meaning, and how they apply the knowledge they have developed and/or created while in school to meaningful tasks. Four words are typical to most definitions of portfolios: purposeful, collection, selection, and reflection. It probably seems obvious, but teachers embarking on portfolios should have clearly determined the "purpose" for their students' portfolios. If the purpose is to show "growth-over-time," then the students' portfolios will likely require evidence of that growth. For example, a growth in writing skills portfolio would very likely include evidence of the students' writing over the course of a year; but it would also probably include evidence of at least one piece of writing for which the student provides all drafts of the piece. Another kind of portfolio is sometimes called a "best work" or "showcase" portfolio. An example of this kind of portfolio is the collection that an artist or trades-person might take to take to a job interview, in which the applicant presents his/her best work. Where growth portfolios would emphasize evolution of skills, showcase portfolios emphasize final products.

Collection and selection need to be thought of as two steps in a process. Collection refers to the entire compilation of the student's work; it is what some teachers refer to as the student's folder. A collection is distinguished from a portfolio in the sense that a portfolio contains those items from the collection purposefully selected to show something in particular. Through the act of selecting, students are challenged to make and frequently to defend decisions about what will best demonstrate to some audience (their peers, an employer, their parents, their teacher, etc.) what they know and are able to do. It is frequently through selection criteria that teachers connect their students' portfolios directly to the curriculum. In other words, if the curriculum required students to "design and conduct field and laboratory investigations to study nature and society" (Show-Me Standard 1.3), then students would select examples of their investigation abilities from across the curriculum. Such a purposeful selection might include such items as a research paper from a history course or an extended laboratory investigation from science.

Reflection may be the characteristic that most distinguishes a portfolio. For some, the real value of the portfolio lies in the students' reflections about their work. Through reflecting back on the work they have produced over some period of time (a quarter, a semester, a year, etc.), students are challenged to articulate for themselves what they have learned, what they are capable of doing, what they have yet to master, etc. In the context of assessing deep understanding across subject areas, this kind of reflection can reveal to students, their parents, and teachers the degree to which they have truly understood the content of multi-disciplinary learning. The student who can explain and document through his or her work across the curriculum how a thinking skill like classification works in science, in mathematics, and in communication arts can be said to have truly mastered the skill. This component of reflection also addresses how the portfolio can be used in evaluation. That is, frequently portfolios contain examples of work that the teacher has already evaluated. Evaluating the portfolio now focuses on the quality of the reflection rather than on the quality of the original product.

Scoring Student's Performance: Identifying Criteria and Creating Scoring Tools

In any instructional activity, the other side of creating and presenting the lesson is assessing its success and the students' demonstrations of what they have learned. This logically leads to a discussion of scoring what the students produce. When a goal of the instruction is to provide students with opportunities to express themselves through sustained writing, drawing, speaking, or any of the other ways students can demonstrate their knowledge and abilities

through performance, scoring becomes more involved that simply applying an answer key. In other words, human judgment once again becomes an integral part of the scoring process. This issue of judgment challenges teachers to consider such concerns as fairness to each student, the time required to evaluate potentially large numbers of assignments, and, potentially, consistency across different scorers. Therefore, this final discussion will examine a variety of scoring tools teachers find useful in dealing with the variety of performances that are typical in performance-based instruction. Fortunately, many of these tools are commonplace to classroom teachers.

Just as teachers use a variety of tools and methods in reaching students of different skill levels and interests, they need a variety of flexible tools to score increasingly open-ended assignments. Recognizing the variety of the ways students are likely to respond to situations, questions, and prompts, teachers must design and implement evaluation tools that are efficient, reliable, and reproducible.

The first and most critical step in designing scoring tools is determining what is significant in the performance; that is, before creating a scoring tool, teachers must establish what they are looking for in the students' work. If the purpose of an assessment was to determine students' knowledge, a traditional answer key is very likely the most efficient scoring tool. If the purpose was to determine whether students know the steps in a process, then a checklist is probably the quickest tool to develop. If the purpose was to determine the students' ability to synthesize several pieces of information and to use that synthesis to solve a problem, then a more holistic scoring tool will be necessary. The point is that the person or group doing the evaluating must first determine what is most important about the students' demonstrations. Once the interest(s) are determined, the evaluator then turns to identifying (or creating) the most efficient, fair, and reliable tool for measuring student success. In practice, many teachers create more than one scoring tool for any given task, project, or portfolio. As with the assessment tool itself, each scoring tool satisfies a particular need.

There's much talk these days about rubrics; unfortunately, much of that talk presumes that there is only one kind of rubric. *Rubric* is really a rather broad term that describes any established criteria for evaluating a response. In this sense, an answer key is every bit as much a rubric as is a holistic rubric. What then is a rubric? A rubric is a simply a scoring guide which sets out the criteria for various score points. It is used to ensure reliability. Essentially, the rubric is an equalizing agent; it provides the means of fairly scoring student responses to open-ended items with great speed. It is a lens to focus several readers—or one reader—to allow them to apply set criteria to varying responses to a prompt. One can describe rubrics as being either prescriptive or descriptive. The former prescribes the qualities expected in the students' responses prior to the student actually performing; the latter describes what is seen in student responses after the performance has occurred. The former sets a standard—a goal—toward which teachers and students should strive; the latter reflects what students are doing at a particular moment in time. All rubrics exhibit the following features:

- They are focused on measuring a stated or identified performance, objective, behavior, or quality.
- They include some form of scale used to rate student characteristics or performance.
- They contain specific and observable performance characteristics arranged in levels indicating the degree to which a standard has been met.

Several types of rubrics are commonly used; each type is suited to deriving particular kinds of information.

Analytic Scales

Analytic scales (or checklists) are commonly used to determine whether the student provided specific information; they are, therefore, more appropriate to questions than they are to prompts. Unless they are somehow weighted, checklists do not indicate a hierarchy of importance; they simply document what is or is not present. Because they treat everything that contributes to a performance individually, analytic scales offer no information about a student's ability to integrate the parts. On the other hand, they are very efficient in letting students know what they must include.

Holistic Scales

Holistic scales are commonly used to derive quick determinations—to get a sense of what is going on in a response. A truly holistic scale is frequently binary, for example, "acceptable" vs. "unacceptable." As such, holistic scales are particularly suited to screening. Because holistic scales emphasize the whole performance rather than the individual parts, they provide some information about a student's ability to integrate knowledge in the service of articulating a position, for example. On the other hand, they offer little in terms of specific diagnosis of student strengths and weaknesses.

Primary Trait Scales

Like holistic scales, primary trait scales provide an effective way to evaluate a large number of assignments very quickly. When used as a diagnostic tool, they can very quickly reveal a student's grasp of a particular concept; for example, if the primary trait under investigation were ability to communicate main idea, then the scorer would only look for evidence of the student's ability to articulate main idea to the exclusion of all other concepts or even skills. When used at the end of instruction, primary trait scales can be used to make particularly fine distinctions within a set of a very similar responses. That is, if a particular trait can be identified as the single most powerful indicator of performance within a score point, students can use this information to make fine adjustments in the performance to increase their success. Constructing a primary trait scale requires identification and ranking of concerns; therefore, by identifying a primary trait, one also identifies and ranks secondary traits. In this way, the scoring tool can communicate to students the relative importance of one skill over another. For example, students sometimes believe that the most important thing about a piece a writing is that all of the words are spelled correctly or that the paragraphs are all indented. It would seem obvious to observe, but a communication that is perfectly spelled and exhibits no grammatical problems but has nothing to say or fails to provide convincing evidence is not a particularly effective communication. By identifying and ranking criteria, teachers can communicate to students that such issues as clarity, organization, effective supporting evidence, etc., must be dealt with prior to surface editing and proofreading.

Registered (or Criterion-Referenced) Holistic Scales

As is implied in the name, registered holistic scales combine the specificity of analytic scales with the "holism" of holistic scales and the sense of hierarchy of primary trait scales. They are commonly used to evaluate complex responses to prompts in which one is looking for demonstration of a variety of skills. While recognizing that a successful performance is more than the sum of its parts, these scales also identify those parts that are most important to the performance and rank them within a score point. By articulating specifically what one is looking for and assigning a level of importance to each, the teacher simultaneously speeds up the "grading" process and imposes consistency across students.

Scales

Scales refer to the number of subdivisions one is able to define for a particular question or prompt. A question might be sufficiently described by "right" or "wrong" (points on a binary scale); however, because prompts do not have a right or wrong answer, they typically require a more complex scale. Practical experience with scales (grade scales, for example) indicates that odd-numbered scales tend to collapse to the middle; that is, when confronted with an odd-numbered scale, scorers sometimes take the easy way out and assign the middle score. Conversely, even-numbered scales force the user to make more definitive decisions.

Anchors

One more term is necessary to this discussion of scoring tools—*anchor*. Where rubrics scribe boundaries around categories of responses, anchors serve as reflections or manifestations of those boundaries. Anchors are actual student responses to prompts and questions; they exhibit in concrete terms what the rubric defines as essential (as opposed to mandatory) characteristics. Ideally, no scoring package would be complete until it included examples of each scoring point. Unfortunately, teachers are not likely to have anchors available the first time they score a new task or project. For this reason, the rubric (or scoring guide) needs to be all the more the precise. Over time, however, teachers will be able to assemble many examples of successful and not so successful performances. These anchors will become invaluable to students (their parents and others interested in the student's performance) as concrete clarification of the scoring standards.

Scoring Student's Performance: Using Scoring Tools

The most important issue is determining what is valued in the particular activity. If all one is after in the activity is the "answer" (for example, in a computation), then the most direct means of scoring is a simple answer key. Clearly, some of what we ask students to do will require nothing more complicated than a traditional answer key. However, if the point of the activity is to teach students how to collaborate with their colleagues, an answer key is just as clearly inappropriate (and insufficient) to the task. Although one could certainly compose a holistic rubric to assess group activity, an observational checklist might be considerably more efficient (and quite sufficient) for the task. For many educators, this first and most important step is frequently the most difficult step as well. All too often, students receive assignments without a clear indication of what is expected of them. Consequently, when they submit their

performances, they do so in hopes that they have met the criteria. Worse than the guesswork involved, not knowing what is expected of them makes them dependent on the teacher for feedback. When expectations are clearly articulated, students learn to become their own best assessors. The challenge for educators is to sufficiently understand what they are looking for in a performance so that they can communicate it to students in a language accessible to each student.

Related to the first concern is the equally important issue of avoiding the tendency to overly emphasize the easily observable or easily describable characteristics. Too often students are provided a scoring tool that oversimplifies expectations. Thus they are lead to believe that labeling the axes of a graph, for example, is more important than the quality of the data or the analysis of the relationships being represented in the graph. When they submit their work, they do so believing they have met the expectations. When, however, they receive feedback the teacher has focused on some deeper concerns that were not mentioned in the scoring tools. The challenge of writing good rubrics is one of figuring out how important dimensions such as problem solving, critical thinking, learning transfer, positive attitudes, etc., can be observed and documented.

The more teachers involve students in the evaluation process, the more students are encouraged to take responsibility for their learning. At the least, students should be provided in advance with the scoring tools and be instructed in how to use them. When appropriate, students at all grades can be involved in the creation of the scoring tools against which they will evaluated. Obviously, when we involve students in their evaluation (whether individually or through peer evaluation), we lessen the degree to which the they are dependent upon us for feedback.

Finally, developing and refining good scoring tools takes time. However, this expenditure of time needs to be compared against other time saved. Those who use rubrics routinely in their classrooms readily admit that whatever time they invest in the development of the tool is offset by the time they save in grading. Rather than agonizing over a student's performance and writing long comments on each assignment explaining the strengths and weaknesses in the performance or justifying the score assigned to it, these teachers simply refer themselves and the student to the rubric for information. Instead of focusing on superficial issues, comments and student conferences now focus on deeper issues of understanding and revision. Probably the most important payback for the time invested in developing scoring tools comes through the greater responsibility students take for their own assessment. Armed with their scoring tools, students (working individually or in groups) now challenge themselves to submit their best performance, clear in their understanding of what constitutes quality work. By the time the teacher is confronted with evaluating the performance, chances are likely that it is a better example of the student's abilities and is, therefore, more enjoyable to review.

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Dear Users of *Missouri's Framework for Curriculum Development in*_____:
(subject)

We hope that this framework has been helpful to you in developing local curriculum aligned with The Show-Me Standards. Please take a few minutes to give the Department of Elementary and Secondary Education comments concerning your use of this document.

1. How did you use this framework? (Explain process.)

2. What parts of the framework were most helpful and why?

3. What suggestions do you have that would help make future versions of this document more useful?

4. If you have specific suggestions concerning certain pages, please indicate those page numbers and explain. Use the back of the page, if necessary.

Important Note:

By the end of the 1996-97 school year, we would also like to publicize Missouri students' quality work at elementary, middle and high school levels related to the Show-Me Standards. As you and other teachers in your district continue to develop performance-based activities/ assessments, please collect samples of quality student work. Samples submitted to DESE should follow the format in Appendix A of the framework.

Please return this sheet with your name and address to the Department of Elementary and Secondary Education, Curriculum Services, PO Box 480, Jefferson City, MO 65102. Call 573-751-2625 for more information concerning submissions of quality student work.

Missouri Department of Elementary and Secondary Education
P.O. Box 480
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